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Interpreting the past through faunal analysis at the Bridge River Site

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INTERPRETING THE PAST THROUGH FAUNAL ANALYSIS AT THE BRIDGE RIVER SITE

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The University of Montana Summer Field School conducted excavations of the Bridge River site during the summers of 2003 and 2004. Bridge River is a large winter pithouse village located in the Mid-Fraser region of the Canadian Plateau. The site is located 3.1 kilometers from the 6-Mile rapids, which is a key fishery on the Fraser River system. Radiocarbon dates obtained from the Bridge River site were divided into four distinct occupations, which are as follows: Bridge River 1 (1864-1696 B.P.), Bridge River 2 (1646-1414 B.P.), Bridge River 3 (1375-1139 B.P.), and Bridge River 4 (638-167 B.P.).

This thesis examines the faunal remains recovered for each occupation of the Bridge River village in attempt to discern changes in predation strategies over time. In addition, predation practices were compared to environmental reconstructions for the Mid-Fraser region. This was done in order to determine if the past tenants of the village implemented new and more cost effective subsistence strategies for differing environmental conditions.

Evenness and richness scores demonstrate that throughout the occupational history of the village predation strategies were consistently salmon dominated. Moreover, environmental reconstructions indicate that throughout Bridge River 2, 3, and 4 the climate was cool and wet. The abandonment of the village between 1138 B.P. and 639 B.P. directly corresponds with the Little Climatic Optimum and the famous Medieval Droughts. Village abandonment during this drought indicates that residents may have found it more cost-effective to focus their subsistence pursuits on terrestrial resources, which eventually shifted their focus away from the village. Overall, it appears the Bridge River village was occupied during periods of enhanced moisture and temperature downturn, which is most likely attributable to the rise in salmon populations during these intervals.

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CHAPTER 1:

INTRODUCTION

Bridge River is a winter pithouse village located in the Mid-Fraser River region of the Canadian Plateau (Figures 1-1 through 1-3). The village consists of 80 subterranean pithouses and 156 external pit features. Radiocarbon dates indicate the site was primarily occupied between 1,864-167 B.P., with four distinct occupations. A long-term research goal is to determine if the site's cultural chronology matches the established cultural chronology for the British Columbia Plateau. In addition, research at Bridge River will allow for a better understanding of the development of large winter pithouse villages, when and why pithouse villages were used more extensively, the development of social complexity, and probable cause for the abandonment of winter pithouse villages at approximately 800 B.P.

Faunal data recovered from Bridge River has the potential to answer many of the research questions previously discussed. By comparing the number of osteichthyes (fish) and mammal remains recovered from each occupation, it will be possible to observe periods of stasis and change in past predation strategies. Moreover, changes in processing and butchery techniques will be examined. Predation practices will be compared to environmental reconstructions for the Mid-Fraser region to determine if shifting environmental conditions may have considerably altered past tenants' dietary regimes. Understanding the reasons for changes in predation practices over time can aid archaeologists in comprehending the development, significance, and abandonment of large winter pithouse villages.

HISTORY OF RESEARCH

The first organized anthropological research to take place within the Mid-Fraser region to examine the social organization, household economies, and the dietary practices of Native groups was conducted by James A. Teit between 1897 and 1900 (Lohse and Sprague 1998). Teit published ethnographic accounts on the Thompson (1900), Lillooet (1906), and the Shuswap (1909) Indians. E.G. Langemann's (1987) M.A. thesis provided the first synthesis of zooarchaeological data for the Lillooet region. Her research was based upon faunal data collected from five Lillooet pithouse villages, including the Bridge River site, excavated under the direction of Arnold Stryd (1971, 1972). The Bridge River site was primarily excavated during Styrd's 1974 field season. Hayden and Kusmer's research at the Keatley Creek Site has focused on social and economic organization in addition to faunal resource utilization (Hayden 1997; Hayden et al. 1986, 2000a, 2000b; Kusmer 2000a, 2000b; Lepofsky et al 1996). Burns (2003) examined past predation strategies throughout the occupation of Keatley Creek's Housepit 7 rim.

RESEARCH GOALS

The ultimate goal of this research project is to determine if predation strategies fluctuated or remained consistent throughout the occupational history of the Bridge River village. Assessing the impact of environmental fluctuations on past predation strategies and determining if past butchery or processing techniques changed throughout time are also important research objectives. Furthermore, socio-economic disparities between medium and large sized housepits for each of the occupations will be evaluated based upon the distribution of fish and mammal remains, in an attempt to discern the advent of social inequality.

An additional research goal is to compare Bridge River predation practices to those hypothesized by Kusmer (2000a), Hayden (1997), Hayden et al. (2000a), and Burns (2003) for the Keatley Creek Village in an attempt to understand the predation history of the Mid-Fraser region. Hayden and Kusmer argue data collected from Housepit 7 epitomizes their belief that salmon provided the economic means for the development, growth, and persistence of large winter pithouse villages within the Mid-Fraser region. They do not believe mammals played a significant role in the diet of prehistoric inhabitants, and postulate salmon reliance remained unchanged throughout the occupational history of the village (Burns 2003). Burns's (2003) data, collected from successive Housepit 7 rims, contradicts Hayden and Kusmer because her research indicates salmon reliance decreased and mammal predation progressively increased throughout its occupational history.

SIGNIFICANCE OF RESEARCH

This research project has the potential to yield new information regarding the diet of prehistoric inhabitants, changes in predation practices as a response to climatic shifts, and possibly status distinctions associated with housepit size. This study could potentially attest to the plausibility of observing predation shifts within dated faunal assemblages, based on what some may consider minor environmental fluctuations. Furthermore, this research will act as a template for upcoming research at the Bridge River site for assessing the significance of changes in predation practices in relation to the development of large winter pithouse villages and social complexity.

Identifying what environmental conditions and subsequent resource advantages would have promoted past tenants of the Canadian Plateau to aggregate within large Mid-

Fraser villages, such as the Bridge River site, is essential for understanding hunter and gather communities throughout the world (e.g., Price and Brown 1985). This study also provides an opportunity to address the importance of resource intensification and mass collection techniques within semi-sedentary hunter and gather communities. In addition, identifying if environmental shifts, resource depression, or another cause is responsible for the abandonment of the Mid-Fraser villages at approximately 800 B.P. could provide archaeologists with a model for assessing hunter and gatherer aggregation and dispersal throughout prehistory.

THESIS OUTLINE

This section provides a brief summary on the organizational composition of this thesis. Chapter 2, Research Background, provides a synopsis of the cultural and environmental data necessary for interpreting research results. Chapter 3, Research Methods and Design, discusses the data collection and recovery procedures, analytical methods, and the theoretical paradigm used to interpret the Bridge River faunal data. The outcome of taphonomic and zooarchaeological analyses are presented within Chapter 4, Results. Chapter 5, Discussion, compares predation statistics to relevant data sets concerning the causes and implications for change. Chapter 6, Conclusions, recapitulates the research and finishes with a discussion of research implications.

CHAPTER 2:

RESEARCH BACKGROUND

In this chapter, I will discuss the environmental and cultural chronology for the Northern Plateau, and more specifically the Mid-Fraser region. Familiarity with the geographic location, environmental history, as well as the events that led up to the development of the Bridge River site, will allow for a better understanding of changes in predation practices. In addition, background data leading up to these changes will enhance assessments of cultural innovations, and the degree to which environmental fluctuations played a pivotal role in instigating them.

REGIONAL OVERVIEW

British Columbia has a total area of 948,000 km^2 and over 85 % of this province is mountainous with elevations ranging from sea level to 3000 meters (Fladmark 1982:97). This province encompasses the Northern Plateau which is marked by the Coast Range to the west, the Columbia Mountains to the east, a line about 65 kilometers below the United States-Canada border on the south, and roughly 52° 30' north latitude (Pokotylo and Mitchell 1998:81). Differential latitudinal and altitudinal floral and faunal species zones, the type of post-Pleistocene soils, major aquatic features (lakes and rivers), prevailing winds, and rain shadows are all geographic and climatic causations, which contribute to the ecology and geographic diversity of the Northern Plateau (Rousseau 2004:3). The Canadian Plateau has an annual precipitation of 25-30 centimeters and is located within the rain shadow of the Coast Range (Pokotylo and Mitchell 1998:81).

The Interior Salish, Kootenai, and Athapaskan linguistic groups are considered indigenous to the Northern Plateau culture area (Pokotylo and Mitchell 1998). The

Upper or Fraser River Lillooet (*Stl'atl'imx*), Shuswap (*Secwepemc*), and the Thompson (*Nlaka7pamux*) are all Interior Salish tribes indigenous to the Mid-Fraser region. All three cultural groups have similar material cultures, which makes it impossible to distinguish them archaeologically. Hayden (1997) states that from middle Prehistoric times (ca. 7,000 B.P.) until Eurocanadian contact there was an unbroken cultural tradition of Salish speaking peoples throughout the Plateau. This continuity provides compelling evidence that past residents of the Bridge River site spoke one of the Interior Salish languages. In contrast, Prentiss and Kuijt (2004) argue for a coastal migration onto the Canadian Plateau around 3,500 B.P. Their conclusions are based upon stylistic and functional lithic analyses of Canadian Plateau artifacts in comparison to those of the Northwest Coast, as well as calibrated radiocarbon dates.

SITE SETTING

The Bridge River site is situated on a broad terrace occupying the north side of the Bridge River at 50.770° latitude and -121.970° longitude, approximately 3.3 kilometers northwest of where the Bridge River and Fraser River convergence. The site lies within the Bridge River Valley, which divides the Coast Mountains from the Camelsfoot Range on the western edge of the British Columbia Plateau (Ryder 1978). A variety of grasses, cactus, Saskatoon berry bushes, rabbit brush, sagebrush, and Ponderosa pine are currently found on the site today. Overall, the Bridge River site is located within the Ponderosa Pine-Bunchgrass biogeoclimatic zone (Mathewes 1978).

PALEOENVRIONMENTAL SUMMARY

Analyzing the relationship between fire histories, patterns of flooding, changes in pollen frequencies, sedimentation within lake/pond basins, and publications on sea floor coring have supplied archaeologists with the data necessary to determine broad regional patterns of paleoecological change (Prentiss, Chatters, and Burns 2005). Synthesizing paleoecological studies in order to develop an understanding of the environmental history of the Canadian Plateau, and more significantly the Mid-Fraser region, is imperative to determining if there is indeed, a correlation between the amounts of osteichthyes remains versus mammal remains found in the archaeological record for different climatic phases at the Bridge River site.

A variety of sources indicate around 2800 B.P. the climate began to warm, which eventually produced drought conditions and summer-dominant precipitation throughout the Plateau between 2800 and 1600 B.P. (Chatters 1998). This time-period was so hot and dry that it has been dubbed the Fraser Valley Fire Period, which occurred between 2400 and 1300 B.P., and is believed to have been caused by prolonged summer droughts (Hallett et al. 2003a). A recent publication by Lepofsky and Peacock (2004) indicates that between 2400-1500 B.P. past residents of the Canadian Plateau were proportionally utilizing higher elevations for geophyte intensification at an increased rate, which would indicate conditions were drier and conducive to geophyte production (Lepofsky and Peacock 2004).

The number of salmon available within the Fraser River system would have decreased during periods of drought, because warmer marine and freshwater temperatures cause a reduction in salmon populations (Chatters 1995; Lawson et al. 2004). Warmer temperatures cause adult prespawning salmon to experience higher and more severe instances of disease (Becker and Fujihara 1987). Furthermore, high sea surface temperatures produce low levels of zooplankton, which causes a decrease in the size of mature salmon. As a result, salmon have less energy stores to migrate up the Fraser River to spawn, which results in higher mortality rates (Crossin et al. 2004). Successive years of drought would have severely depleted salmon populations, which would have increased the importance of productive salmon fisheries located within the Mid-Fraser region.

Drier conditions result in more forest fires, which opens up the forest canopy and allows for the expansion of ungulate foraging grounds (Kie 1984; Taper and Gogan 2002). A study by Carlson et al. (1993) found that the burning of pineland forests caused an initial increase in the nutritional quality of plant resources located within the burn, and eventually provided prolonged benefits in browse quality. Furthermore, berry-producing plants typically colonize burned areas, providing the Mid-Fraser tenants with an abundant food source (Fischer and Bradley 1987; Franklyn and Dryness 1988). In addition, dry conditions and burned areas promote and support vegetative communities that produce many edible geophytes within interior British Columbia (Turner 1991).

Between 1600 and 1300 B.P., the Mid-Fraser region was undergoing a transition from warm and dry environmental conditions to those that are cool and wet. As mentioned previously, drought conditions were at their worst between 2000 and 1600 B.P.; however, a study on the fire history and climate of the southwestern British Columbia mountain hemlock rainforests indicates the Fraser Valley Fire Period lasted until 1300 B.P. (Hallett et al. 2003a). A study by Reyes and Clague (2004) concluded between 1600 and 1300 B.P. there are well-dated glacier advances of the Bridge and Lillooet Glaciers, which indicates cooler and wetter environmental conditions. However, they do address the work of Hallett et al. (2003a) and recognize that during this time-period there were dry fuel conditions caused by drought. They conclude that, "the occurrence of glacier advances during a period that was probably dominated by conditions leading to enhanced loss of glacier mass during the ablation season may reflect the importance of winter climate, in particular precipitation, for producing positive net mass balance and hence glacier advance" (Reyes and Clague 2004).

Fish bone counts from the Saanich core off the British Columbia coast suggest marine productivity improved ca. 2000-1800 B.P., and steadily progressed until approximately 1100 B.P. (Tunnicliffe et al. 2001). An increase in fish bone counts indicates oceanic temperatures were cooler, and conducive to the rearing of large fish populations. However, fish bone counts recovered from the Saanich inlet are limited to three drilling holes at one site, and therefore the small sample size must not be over interpreted. Overall, environmental data indicates a cooling trend, which would have affected the Mid-Fraser region at approximately 1700-1600 B.P.

As mentioned previously, the Fraser Valley Fire Period ended at approximately 1300 B.P., which was most likely the result of cooler and wetter environmental conditions. Between 1300 and 1100 B.P. there is a sharp increase in the concentration of fish remains from the Saanich core off the British Columbia coast (Tunnicliffe et al. 2001). Data from the Santa Barbara Channel also indicates the eastern Pacific was cooler during this time-period (Finney et al. 2002). Climate, fisheries, and fire data all indicate cool and wet environmental conditions persisted within the Mid-Fraser region until approximately 1200 B.P.

Increased moisture and temperature downturn would have caused an increase in salmon populations (Chatters et al. 1995) and enhanced fishing opportunities throughout the interior. In contrast, moister conditions promote the expansion of forests causing a decrease in ungulate populations and geophyte and berry production. Studies have shown that long and cold winters, characteristic of cooler and wetter environmental conditions, cause deer populations to deplete local foraging grounds, which leads to starvation and decreased natal fawn survival (Kucera 1976; Ransom 1964; Hamlin and Mackie 1989; Garroway and Broders 2005).

Between 1100 and 700 B.P. there was another warm and dry period within the Mid-Fraser region. Vegetative patterns and ecological succession data clearly indicate drought conditions (Chatters 1996; Hallett et al. 2003b; Hallett and Walker 2000), which is also when the Little Climatic Optimum peaks. Furthermore, fire succession data indicates that within the interior Northwest fires were more frequent after 1100 B.P., and then occurred frequently and intensely between 900 and 700 B.P. (Chatters 1996; Hallett et al. 2003b; Hallett and Walker 2000). Mohr et al. (2000) observed that fire rate frequencies reached high levels ca. 1000 B.P. within the Klamath Mountain Range of Northern California. Moreover, local tree ring data shows drought conditions were prevalent at this time. In addition, there is not evidence to indicate the Lillooet Glacier advanced between 1300 B.P. until ca. 470 B.P., which also signifies warm and dry environmental conditions (Reyes and Clauge 2004).

Fisheries data also indicates warmer temperatures and less precipitation. The number of sardine scale frequencies recovered from cores in the northeastern Pacific and fish bone counts from the Saanich inlet both indicate warmer oceanic conditions by 900 B.P. (Finney et al. 2002; Tunnicliffe et al. 2001). However, the overall numbers of fish off the British Columbia Coast began to fluctuate at approximately 1100 B.P., which may signify that oceanic temperatures were changing prior to 900 B.P. There is also a decline in the number of salmon found within the Columbia River system during this time-period (Chatters et al. 1995).

As mentioned previously, increased temperatures would have had adverse affects on salmon populations (Chatters et al. 1995; Lawson et al. 2004; Becker and Fujihara 1987; Crossin et al. 2004). However, foraging conditions for deer and elk would have improved, as well as geophyte and berry production.

The Little Ice Age, which began around 800-700 B.P., brought cooler and wetter temperatures into the Mid-Fraser region around 600 B.P. Fire records demonstrate that during the Little Ice Age (600-150 B.P.) fires are rare, which signifies the climate was cooler and wetter during this time-period (Hallett et al. 2003b). Based upon the type of flora present within interior British Columbia during the Little Ice Age, scientists have been able to deduce that the environment was moister around 500 B.P. (Chatters 1996; Chatters and Leavell 1995; Hallett and Walker 2000; Prentiss, Chatters, and Burns 2005). Chatters et al. (1995) found that between 700 and 200 B.P. conditions on the Columbia River are "good" for salmon populations.

Cooler and wetter climate would have caused salmon populations to increase within the Mid-Fraser region. Once again, the forests would have closed in reducing geophyte and berry production. Deer and elk populations would have shrunk due to a reduction in open grasslands and depleted winter foraging grounds.

CULTURAL CHRONOLOGY

Archaeologists working in the Northern Plateau often differ on their interpretations and names for the different chronological traditions and horizons associated with the Mid-Fraser region as well as the Canadian Plateau. For this study, I will use the cultural chronology developed by Stryd and Rousseau (1996) Richards and Rousseau (1987), and Rousseau (2004) as an outline for delineating the cultural sequences associated with the study area.

The Early Period: 11,000-7,000 B.P.

The Early Period on the Northern Plateau originated after de-glaciation and ends shortly after the Hypsithermal Period (Hebda 1982). Environmental conditions during the Early Period would have been warm and dry due to the onset of the Hypsithermal. Warm and dry environmental conditions may have provided the appropriate conditions, such as grassland habitats, to support fauna suitable for human predation (Stryd and Rousseau 1996:180).

The Early Period is only represented by a scattering of projectile points, which some archaeologists believe is attributable to the dynamic nature of the environment rather than lack of human activity (Chatters and Pokotylo 1998:74). So far, the earliest definitive evidence of human occupation on the Northern Plateau was documented at the Landels site in Oregon Jack Creek Valley, which was utilized 8,500 years ago (Pokotylo and Mitchell 1998:83). This site also provides the earliest direct evidence that past inhabitants of the Northern Plateau utilized a microblade technology (Stryd and Rousseau 1996:184). The postcranial remains of a young adult male has been recovered at the Gore Creek site located in the South Thompson River Valley, and has been radiocarbon dated to approximately 8,500 BP. Stable carbon isotope analysis of the human remains indicate an eight-percent reliance on marine resources, which would tend to indicate that past tenants relied more on terrestrial resources (Chisholm 1983; Stryd and Rousseau

1996:184). The Drynoch Slide site located south of Spences Bridge in the Thompson River Valley has been radiocarbon dated to 7,530 +/-270 BP. Faunal data indicates a reliance on large ungulates and fish, most likely salmon (Stryd and Rousseau 1996:185). Residents of the Early Period have been identified as residentially mobile foragers who lived in small groups and varied their subsistence patterns depending on the seasonal potentiality of their local environment (Chatters and Pokotyolo 1998:74).

Middle Period: 7,000-3,500 B.P.

The Middle Period spans from the beginning of the Nesikep Tradition until the establishment of the Shuswap horizon at 3500 B.P. (Stryd and Rousseau 1996:185). Between 5000 and 4500 B.P. there was a climate shift from warm and dry environmental conditions to those that were cool and wet, which would have caused pine and Douglas fir forests to expand (Rousseau 2004). The Middle Period consists of one tradition and three phases; however, Rousseau (2004) categorizes the Lochnore phase as part of the Plateau Pithouse Tradition. This discrepancy will be further explained within the Lochnore phase section.

Nesikep Tradition 7,000-3,500 B.P.

The Nesikep tradition has been further divided into the Early Nesikep Phase (7,000-6,000 B.P.) and the Lehman Phase (6,000-4,500 B.P.) (Stryd and Rousseau 1996; Rousseau 2004:4). This tradition is thought to be the result of a mix of early regional cultures that developed a distinct interior ungulate hunting culture, possibly because of cooler and wetter environmental conditions (Stryd and Rousseau 1996; Pokotylo and Mitchell 1998:83).

Early Nesikep Phase 7,000-6,000 B.P.

The Early Nesikep Phase is identified as an interior ungulate hunting culture with a foraging adaptive strategy (Pokotylo and Mitchell 1998:83). During the Nesikep Phase residential base and field camps were typically small, were occupied for short periods of time, and were often located near water and fishery resources (Rousseau 2004:5). Rousseau believes regional population densities during the Early Nesikep were lower than those of other periods, because most residential base camps are smaller and less common. However, he is quick to point out that the decrease in site frequency may be attributable to low site visibility or deflated blowouts along terrace edges (Rousseau 2004:6).

According to Stryd and Rousseau (1996) the following are characteristic of the Early Nesikep Tradition: well made, lanceolate, corner notched, and barbed projectile points; formed unifaces; a microblade technology using wedge-shaped microblade cores; antler wedges; ground rodent incisors; bone points and needles; red ochre; and small oval scrapers. Faunal assemblages indicate a heavy reliance on deer, with less emphasis on elk, salmon, steelhead trout, bird, and freshwater mussels (Rousseau 2004:6).

Lehman Phase 6,000-4,500 B.P.

Radiocarbon dates, lithic tool repertoires, subsistence practices, and clear continuities in technological traits all indicate that the Lehman Phase people were direct descendents of the Early Nesikep (Rousseau 2004). Due to low site densities and the small size of Lehman sites, population levels are thought to have been relatively low. However, population densities are estimated to be much higher than those postulated for the proceeding Nesikep Phase, which indicates a steadily growing population throughout the Nesikep Tradition (Rousseau 2004:9).

This Phase is characterized by the Lehman obliquely notched point type and lanceolate knives with straight, cortex-curved bases (Pokotylo and Mitchell 1998:84). Faunal assemblages indicate an emphasis on hunting, particularly deer and elk, from 6,000-5,000 BP and more incorporation of salmon resources into the diet after 5,000 BP (Rousseau 2004:10).

Lochnore phase: 5,000-3,500 B.P.

Canadian Plateau archaeologists differ on when the transition from the Lehman Phase to the Lochnore Phase occurred, and whether the Lochnore Phase marks the beginning of the Plateau Pithouse Tradition. Stryd and Rousseau (1996) and Rousseau (2004) argue that Lochnore populations developed a collector adaptive strategy as a result of direct and indirect contact with people from the South and Central coast region, between 5,000 and 4,500 B.P. Furthermore, they believe this contact and exchange of cultural systems, ideas, and technology provided the foundation for the complex village pattern characteristic of subsequent periods (Prentiss and Kuijt 2004:49-50). Alternatively, Prentiss and Kuijt believe the Plateau Pithouse Tradition occurred after the Lochnore Phase as a result of coastal populations immigrating into the interior around 3,500 B.P. (Prentiss and Kuijt 2004; Kuijt and Prentiss 2004).

Many archaeologists agree between 5,000 and 4,500 B.P. there was a shift from warm and dry environmental conditions to those that were cool and wet by 3,500 B.P., and that this change in climate would have severely altered local environments, ecosystems, and cultural patterns (Kuijt 1989; Kuijt and Prentiss 2004; Prentiss and Kuijt

2004; Rousseau 2004). Lithic artifacts associated with the Lochnore Phase include notched, leaf-shaped bifaces; a variety of specialized unifaces including circular, crescent, and end scraper styles; notched pebbles; and microblades (Prentiss and Kuijt 2004:50). Lochnore people are believed to have practiced a "forager" subsistence strategy (Pokotylo and Mitchell 1998:85). Faunal assemblages indicate inhabitants of the Lochnore Phase utilized an opportunistic and generalized subsistence strategy, which provided them with a variety of resources including deer, elk, beaver, migratory fowl, anadromous salmonids, turtles, and freshwater mussels (Rousseau 2004:14). There is no direct evidence of significance salmon reliance during the Lochnore Phase (Rousseau 2004:14).

The Late Period: 3,500-200 B.P.

Richards and Rousseau (1987) recognize three cultural horizons associated with the Plateau Pithouse Tradition. In a recent publication, Rousseau (2004) has extended the Plateau Pithouse Tradition from 4,500 B.P. to 200 B.P., encompassing much of the Lochnore Phase. For this study, I will rely on the 3,500 B.P. date provided by Richards and Rousseau (1987) and Prentiss and Kuijt (2004), to indicate the beginning of the Plateau Pithouse Tradition on the Canadian Plateau. The Plateau Pithouse Tradition is "a cultural tradition characterized by semi-sedentary, pithouse dwelling, hunter-gatherer, logistically organized (Binford 1980), band-level societies that relied heavily on anadromous fish for subsistence" (Richards and Rousseau 1987:21).

Shuswap Horizon 3,500-2,400 B.P.

During the Shuswap Horizon, there was enhanced moisture and cooler temperatures, which has been termed the Neoglacial Period (Chatters 1998; Pielou 1991).

Faunal evidence indicates inhabitants of the Shuswap Horizon ate a variety of animal food resources, relied heavily on meat, and did not practice intensive salmon drying and storage. The absence of rigorous salmon drying and storage is most likely attributable to the abundance of resources available (Rousseau 2004:15).

Residents of the Shuswap Horizon developed, "a more logistically organized collector adaptation with some food storage and regular winter residency in pithouses" (Rousseau 2004:15). Shuswap pithouse were large (averaging 7.6 to 16.0 meters in diameter), commonly had hearth features, internal storage and cooking pits, earth roof insulation layers, and ground-level side entrances (Richards and Rousseau 1987:25). Conversely, radiocarbon dates obtained from housepit floors dating to the Shuswap Horizon indicate pithouses were generally small and less then 10 meters in diameter (Lenert 2001; Lenert and Goodale 2001). Throughout the Shuswap Horizon residential mobility decreased, population levels increased, and small seasonal residential sites in resource-rich valley bottoms transpired with brief occupational episodes and low instances of reoccupation (Rousseau 2004:15).

Lithic artifacts associated with the Shuswap Horizon include a variety of stemmed, basally indented and corner removed projectile point styles, key-shaped formed unifaces, small "thumbnail" scrapers, split-cobble scraping tools, and high frequencies of utilized and unifacially retouched flake tools (Rousseau 2004:15). In addition, Shuswap people tended to use lithic raw materials of fair to good quality found near winter villages and field camps (Rousseau 2004:15). Artwork is rare during the Shuswap Horizon and there is evidence of a well-developed bone and antler technology where preservation is superior (Richards and Rousseau 1987; Rousseau 2004).

Plateau Horizon 2,400-1,200 B.P.

The Plateau Horizon is generally characterized by warm and dry conditions, with a trend towards those that are cool and wet between 1600-1100 B.P. It is during this horizon large pithouse villages emerge, and population levels are at their peak (Hayden 1997, 2000b; Rousseau 2004). Small (<10 m), medium (10-14 m), and large (>15 m) housepits appear throughout the horizon with smaller housepits more prevalent towards the beginning of the horizon, and large housepits more common in latter years (Lenert 2001). Large villages were generally located near optimal resource locales such as productive fisheries, were reoccupied over long periods of time, and contained numerous food storage pits (Rousseau 2004).

The use of task specific field camps in mid to upland environments, food storage, and task specific artifacts all indicate a logistically organized collector subsistence strategy was in use during this Horizon (Rousseau 2004:17). The introduction of the bow and arrow onto the Canadian Plateau at approximately 1500 B.P. would have reorganized hunting strategies, allowing hunters to be more successful and to allocate more time to other pursuits (Rousseau 2004). Plateau Horizon tenants relied heavily on salmon, and exploited deer, freshwater mussels, and root resources (Richards and Rousseau 1987:40). Stable-carbon isotope analysis of human skeletons form the Lillooet vicinity, dating to 1600 and 1200 B.P., show that approximately 60% of the diet came from marine resources (Chisholm 1983; Richards and Rousseau 1987:39).

During the Plateau Horizon, there is an increase in the quality of lithic materials as well as workmanship (Richards and Rousseau 1987:34). Projectile points are most always bilaterally barbed with either corner or basal notches and "key-shaped" unifaces are common (Richards and Rousseau 1987; Rousseau 2004). There is an increase in scrapers, bone, antler, tooth artifacts, copper artifacts, and nephrite within in the archeological record (Richards and Rousseau 1987). In addition, inhabitants of the Mid-Fraser region maintained exchange relationships with resident groups on the Plateau and the Northwest Coast. This would have allowed them to obtain prestige items, such as dentalium shells and fish oil and fat.

The Kamloops Horizon 1,200-200 B.P.

Similar to the Plateau Horizon, residents of the Kamloops Horizon lived in large pithouse villages, practiced a logistically organized subsistence strategy, utilized mid to upland base camps, participated in regional exchange networks, and practiced a unique Plateau art tradition (Rousseau 2004:19). Kamloops Horizon people differed from those of the Plateau Horizon in that they used "Kamloops side-notched" points, utilized less upland plant resources, lived in medium to large sized housepits with a variety of floor plans, and experienced a reduction in population numbers (Rousseau 2004:19). There is a marked increase in ground stone, bone, antler, and tooth artifacts. The presence of a sophisticated fishing technology indicates salmon and steelhead trout continued to be an important dietary staple (Richards and Rousseau 1987).

While other archaeologists would argue for a much earlier date for the rise of social inequality within the Mid-Fraser region of the Canadian Plateau, Prentiss, Chatters, and Burns (2005) maintain that there is not evidence of interhousehold differences in food remains and artifacts prior to the Kamloops Horizon. Prentiss, Chatters, and Burns (2005) postulate that drought conditions existing between 1,000 and 700 B.P. induced resource stress. This stress would have increased the importance of access and control to key fishing locales, hunting grounds, lithic procurement areas, and possibly even geophyte harvesting localities. Under these conditions, it would have been advantageous for family corporate groups to live together to share resources and to sustain their power and control over key resource locales.

Archaeologists agree after ca. 800 B.P. the pithouse villages located within the Mid-Fraser region were abandoned (Prentiss et al. 2003). Hayden and Ryder (1991) believe a landslide took place approximately 1,100 years ago, which blocked the Fraser River, and impeded salmon migrations and access to spawning grounds. As a result, they believe Mid-Fraser tenants abandoned the large winter pithouse villages in favor of other food resources. However, as Kuijt (2001) points out, the landslide in question has not been dated and could have occurred much earlier than Hayden and Ryder predict. Prentiss (personal communication) believes the abandonment of large winter pithouse villages within the Mid-Fraser region is the result of drought conditions and low salmon productivity between 1000 and 600 B.P.

LAND USE BY PREHISTORIC MID-FRASER TENANTS

The Interior Salish groups of the Mid-Fraser region were not tethered to one particular biotic zone, but rather practiced seasonal rounds. Teit's exceptional ethnographic accounts of the people native to the Mid-Fraser region prior to large-scale Eurocanadian contact, as well as the long-standing cultural continuity of Interior Salish groups, have allowed archaeologists to reconstruct historic land use patterns. Ethnographic accounts and archaeological evidence indicate that mid-Fraser tenants occupied and utilized resources from the alpine, montane parkland, montane forests, intermediate grassland, intermediate lakes, river terraces, and river valley ecological zones (Alexander 1992).

During the winter months, residents of the Mid-Fraser region occupied winter pithouse villages located on river terraces. Throughout the cold season, people would live off their stored foods and participate in social activities. The men would spend the winter manufacturing tools and weapons, and if weather permitted hunted deer in the grasslands or ice fished in the intermediate lakes (Alexander 1992). February was a particularly stressful month for tenants of the Mid-Fraser region, especially if the food reserves were running low.

As the snow packs melted in the alpine, family groups would have taken short trips to hunt deer and gather plants as they ripened (Alexander 1992). Trout fishing in the intermediate lakes and montane parklands, fishing for spring salmon in the river valleys, and root and plant gathering in the intermediate grasslands were all activities that typically took place in the spring months (Alexander 1992). Fresh meat, plants, and fish must have been a welcome culinary delight for the Mid-Fraser peoples, after a winter of subsisting primarily on stored foods.

Hunting deer and elk, plant and root gathering, and picking Saskatoons and other berries were all summer activities, but the most important summer subsistence activity was salmon fishing. Salmon is considered the number one ranked food source within the Mid-Fraser region, and was essential to their survival. By late August, the salmon runs had tapered off. At this time families would relocate to pursue other subsistence activities (Alexander 1992).

Men would hunt in the mountains during the fall and woman would gather seeds and prepare hides (Alexander 1992). During their forays into the mountains, men would have gathered raw materials to manufacture stone tools and weapons during the winter months. As the weather cooled, family groups would have drifted back to the winter villages to prepare for the upcoming winter.

This section is merely a summary of the subsistence activities in which Mid-Fraser tenants participated in to acquire food resources. It would be safe to infer Mid-Fraser peoples were very opportunistic, and would have utilized numerous resource zones for various food-gathering activities. Overall, each food gathering activity played a central role in the survival of the Mid-Fraser people. Most likely, their broad diversification of food resources afforded them success in an environment characterized by long, harsh winters.

HOUSEPIT SITE AND FORMATION PROCESSES

To comprehend the formation process responsible for the distribution of faunal remains and other artifacts at the Bridge River site, it is essential to understand why and how pithouses were constructed, what time of the year they were occupied, how they were spatially organized, and how they were disassembled. With the assistance of accurate maps, climatic records, and ethnographic accounts, archaeologists have been able to demonstrate a correlation between pithouse use and climate (Hayden et al. 1996; Alexander 2000). Their conclusions have shown semi-subterranean pithouses are used in environments characterized by long cold winters and dry conditions, which is precisely the type of environment present in the Mid-Fraser region. Alexander (2000) has determined that the aboriginal inhabitants of the Mid-Fraser region preferred pithouses to aboveground housing structures because:

> "1) in the cold winters of the Interior Plateau, pithouses were better insulated and required less wood to heat, 2) the dry conditions made subterranean foundations practical, and 3) the abundance of salmon in the Fraser River allowed for a high population density and more sedentary lifestyle where the greater time and effort needed to construct a pithouse was made feasible and effective by large groups living in the same location for four to five months every year."

Teit's (1906) ethnographic accounts of the Lillooet Indians specify that "almost all of the Upper Lillooet lived in semi-subterranean dwellings during the winter." Hayden (2000a:4) has not found evidence to indicate Mid-Fraser pithouse villages were occupied during any other season than winter, but does find it plausible the elderly, very young, and infirm, could have intermittently occupied the villages throughout the entire year. Recognizing the Bridge River site was a winter village is an important component of the site's formation processes and influences the type of artifacts present within the archaeological record.

Pithouse construction techniques differed throughout the Plateau, however most of the semi-subterranean houses found within the Mid-Fraser region were circular and generally varied between five to fifteen meters in diameter (Teit 1906). Women using digging sticks, wooden scrapers, large woven baskets, and their hands generally excavated the housepit depressions. The exhumed soil was placed near the perimeter of the hole, so it was easily accessible for redistribution on the roof (Alexander 2000). Figure 2-1 is James Teit's 1900 rendition of a pithouse.

Four large beams generally set into the corners of the floor at a 30° angle, provided the support structure for the roof of a typical pithouse. A square hole was left in the roof for smoke ventilation, which simultaneously provided pithouse access with the aid of a ladder. Horizontal poles were usually tied to the beams and side braces to support the roof covering (Alexander 2000:57). Subsequently, split wood slabs or poles were placed at right angles or horizontally over the frame of the house. Materials such as straw, dry grasses, and dry pine needles, were used to obstruct any openings between the wooden slabs. This was done in an effort to prevent soil placed on the roof from falling through the cracks, to facilitate drainage, and to prevent moisture from seeping through (Alexander 2000). The final phase of pithouse construction was to firmly beat down the exhumed soil on top of the roof. As Orcholl (2004) points out, the earth used to cover the roof was excavated from the housepit depression; therefore, in cases of reconstruction there is a good possibility the roof layer would contain redeposited cultural materials.

Ethnographic evidence indicates the middle of the pithouse was considered a communal area. A central hearth was built under the doorway and was used by multiple families; however, in the larger houses each family may have had their own fire (Alexander 2000). Wooden sleeping benches or log platforms were often constructed around the perimeter of the pithouse, and the dirt walls were sometimes lined. Food was stored in elevated cache pits, external cache pits located either in or outside the confines of the village, within internal cache pits located within the pithouse itself, and on shelves constructed between the roof and the top of the wall (Alexander 2000).

It is important to consider the activities that took place within a winter pithouse village and how they would have influenced artifact distributions and subsequent archaeological interpretations. For example, some men among the Thompson were skilled in a particular craft, and traded their wares for other commodities (Teit 1900). "This division of labor may be reflected in the archaeological record with some housepits or hearths exhibiting a disproportionate representation of certain activities" (Alexander 2000). Sometimes, activities such as smoking fish and meat and tool manufacture were performed in abandoned pithouses (Alexander 2000). Artifacts distributed within abandoned pithouses could potentially skew archaeological interpretations, if these factors are not taken into account.

Recognizing and accounting for how artifacts were discarded is an important component of archaeological interpretation. According to ethnographic accounts, pithouse tenants often covered the floor with evergreen boughs that were replaced every three to four days (Alexander 2000). In combination with sweeping the floor areas and dispensing of the evergreen boughs it is logical to assume debris, such as faunal remains, would have regularly been eradicated from pithouse floors. Alexander (2000) speculates debris would have accumulated in low traffic areas, such as the peripheries of the pithouse and under sleeping benches. Food and bone remains are thought to have been thrown out of doorways onto the pithouse roof (Alexander 2000). However, archaeological investigations suggest there was less clean up of food refuse than documented within ethnographic records.

Pithouses lasted about twenty years before they had to be rebuilt or abandoned. If rebuilding in the same location, Mid-Fraser tenants often disassembled pithouses and reused the viable wood products (Alexander 2000). Burning the pithouse down and starting a new one was another method of pithouse disassembly, which was commonly found at the Bridge River site. This method of demolition would have been significantly faster than manually disassembling the pithouse superstructure; however, potentially valuable wood products would have been destroyed.

Salmon as a Resource

Salmon was such a significant food resource in the lives of the original inhabitants of the Northwest Coast and Plateau, and they depended on it to such a significant degree, the survival of the populations depended on its availability (Kew 1992; Romanoff 1992a:222). Therefore, it was extremely important that sufficient quantities were harvested, processed, and stored each year to prevent food shortages. Salmon is considered the motivating factor for the development of large winter pithouse villages in the Mid-Fraser region, because it allowed aboriginal populations to lead a semi-sedentary lifestyle. The abundance and predictability of salmon would have warranted the increased investment of time and energy required to construct winter pithouse villages (Kuijt 1989:108).

Five species of salmon regularly traverse up the Fraser River and its tributaries to spawn at pre-determined time intervals. According to Berry (2000):

> "Each of these species of salmon exhibit unique qualities which influence the ways in which a culture might procure, process, and use the fish. Such qualities as fat content, difficulty of catching the fish, the season of spawning, the number of fish each species would return up the river each year, the size of the fish, and even the taste are important traits."

The following is a brief summary of the five salmon species harvested by the Mid-Fraser tenants and their distinctive qualities based primarily on information presented in Berry (2000).

Pink salmon (*Oncorhynchus gorbusha*)

Ethnographically, pink salmon did not play an important role in the diet of Mid-Fraser tenants, which is thought to be attributable to their small size and lack of taste. This variety of salmon spawns every two years and is found in the Fraser River between September and October. They are considered to be one of the easiest salmon species to catch and dry.

Spring salmon (*Oncorhynchus tshawytscha*)

This species of salmon is also known as king or chinook, is the largest, and is the most widespread throughout the Fraser River system with an average weight of 6.8 kilograms (Kew 1992:181). Spring salmon generally spawn at four to five years of age. They have two main runs up the Fraser River, with the first occurring between March and April and then another between August and September. Ethnographically, the natives preferred this species of salmon even though it was one of the more difficult to catch. Spring salmon are relatively oily, so processing and drying this fish is more time consuming (Romanoff 1992).

Sockeye Salmon (*Oncorhynchus nerka*)

Sockeye salmon usually spawn at four to five years of age and only the spring salmon is considered more desirable. This variety of salmon appears in the Lillooet region around June with a series of runs lasting through October (Kennedy and Bouchard 1992:272). Although sockeye salmon have a balanced oil content and a rich flavor, they are a difficult fish to dry. Ethnographic records indicate that this fish was often traded or immediately consumed (Romanoff 1985; Berry 2000).

Chum Salmon (*Oncorhynchus keta*)

Chum salmon is also known as dog salmon and are found within the Fraser River system primarily at four years of age during October and November. This salmon species is not currently found near the Lillooet area as it only runs 200 miles up the Fraser River system. However, this does not mean that during prehistoric times this was the case. This species of salmon elicits mixed reviews throughout the Northwest with some people ridiculing it as a tasteless fish, and others commending its preservation qualities (Berry 2000).

Coho Salmon (*Oncorhynchus kisutch*)

This variety of salmon is also known as silver salmon. Coho salmon travel upriver to spawn at three years of age in November and December, but are uncommon within the upper Fraser River system. Their preservation qualities are considered average and they are slightly larger than pink salmon (Romanoff 1985; Berry 2000).

Ethnographic records, pertaining to the preservation and storage of salmon within the Lillooet region, can assist in archaeological interpretations for the distribution and types of salmon remains found at the Bridge River site. The Bridge River site is located 3.1 kilometers from the 6-Mile rapids, which is a key fishery on the Fraser River system. The Fraser River Lillooet (*Stl'atl'imx*), people indigenous to the Bridge River area, still exploit this productive fishery today. Therefore, it is reasonable to assume aboriginal populations also made use of this locale.

The Lillooet area provides exceptional salmon preservation conditions because of its hot, dry climate during the summer months, windy conditions near the Fraser River, and the abundance of low-fat fish. The primary method of salmon preservation within the Mid-Fraser region was to dry salmon filets on drying racks, built perpendicular to the river. The filets were hung parallel to the river, which enabled the wind to move freely over the drying flesh. During times when drying conditions were not sufficient, or when fish with a higher fat content were to be preserved, the fish was smoked. In the interior drying conditions were so adequate that only an occasional smudge fire was sufficient (Romanoff 1992a).

The Bridge River site was occupied during the winter months, which significantly influences the element and species of salmon remains present within the faunal assemblage. Early ethnographic accounts indicate spring salmon were preferred in the Lillooet area. Spring salmon were favored because during the later runs their fat content was less than that of the sockeye, which meant they could be stored longer and there was less chance they would spoil after they were wind-dried (Kennedy and Bouchard 1992:308). Currently, the Lillooet natives principally harvest sockeye salmon; however, early ethnographic accounts indicate they were often immediately consumed or traded because they were a more difficult fish to dry. Fat content would have played a significant role in determining which species of salmon would have been stored for consumption during the winter months, and consequently would influence the occurrence of certain salmon species within the archaeological record.

Ethnographic data recorded by Romanoff in the early 1970's indicates the Fraser River Lillooet used two filleting techniques to prep sockeye salmon for wind drying. Primarily, sockeyes are processed so a single filet of the whole fish attached to the backbone and ribs at the tail is produced. The second method generates two filets attached at the tail with the backbone removed (Romanoff 1985; 1992a:135).

Ethnographically both Teit (1900) and Kennedy and Bouchard (1992) indicate the backbones or "neckties" were dried separately or removed from the filet after it had dried. Salmon backbones were eaten as snacks or used to make fish soups during the winter. Teit (1900) observed that the backbones of salmon caught late in the fall by the Thompson Indians, who he describes as having a similar fishing economy as the Lillooet, were not removed. The salmon was simply gutted, scored along both sides of its body, and then dried for winter storage.

The Fraser River Lillooet utilized numerous parts of the salmon to prepare different food items and for storage. Salmon heads were dried and stored, and could later be boiled to make soups. The eyes of the salmon were also dried and eaten (Kennedy and Bouchard 1992). Salmon-roe was wrapped in dry grasses or bark, buried until almost completely rotten, and then roasted or boiled for consumption (Teit 1900). Salmon oil was prepared by placing heated stones in boiling water with fatty salmon parts. Next, the mixture was boiled until all of the oil was skimmed off the top. Finally, the oil was placed in pre-prepared salmon-skins and the remaining salmon flesh was either eaten or dried into cakes (Teit 1900; Kennedy and Bouchard 1992). Powdered salmon, which is salmon simply pounded with a hammer or pestle, was also stored and eaten. Hayden (1997) observed salmon fin remains occurred more often within the smaller pithouses excavated at the Keatley Creek site, which indicates some people kept the fins for food.

Most of the preparation techniques discussed in the proceeding paragraph are difficult to near impossible to identify within the archaeological record, because they do not revolve around the preservation of the bony parts. In addition, backbones or salmon heads used to make soups would have been softened and more vulnerable to decay and disintegration, making it more difficult to interpret their presence within the archaeological record (Hayden 1997). Furthermore, many of the salmon bones were removed from the filets prior to transporting them to the winter pithouse villages.

The storage strategies and techniques of the Fraser River Lillooet would have influenced the number of salmon remains within the archaeological record. Dried salmon was stored in underground cache pits, elevated wooden box caches, and wooden storage platforms (Alexander 2000). Several hundred fish could be stored in an elevated wooden box, which could be built in trees or on a pole platform with four supports. The wooden box-caches were built to impede mold growth and were stored by the river so the wind would keep the salmon dry (Romanoff 1992a). Underground cache pits were lined with birch bark, maple sticks, and grasses to prevent insect infestations and mold (Alexander 2000). These cache pits were often located within pithouses, the confines of the village, or some distance away. Hayden (1997) observed that at Keatley Creek articulated salmon backbones were sometimes left in the bottom of pits. He feels backbones may have been left in pits because they went rancid, or because they were so insignificant it was not worth the effort to remove them.

Mammals as a Resource

According to Romanoff (1992b), hunting was the main activity after salmon fishing and was a critical resource for the Lillooet, because deer meat could be used as a supplement when salmon runs were less productive or more difficult to preserve. Hunting was an elite occupation among the Lillooet and a successful hunter could incur rewards such as multiple wives, labor, and gifts (Kennedy and Bouchard 1998:179). This was primarily a fall activity and took place in the alpine and montane parkland ecological zones, and to a lesser extent in the grasslands and river terraces (Alexander 1992). Lillooet hunters used bows and arrows, deer fences, snares, nets, clubs, spears, dogs, canoes, and knives to acquire game.

Mule deer was the most important source of meat for the aboriginal Lillooet. According to Teit (1906), they also hunted black-tail deer, bighorn sheep, hoary marmot, black bear, caribou, grizzly bear, rabbit, rock rabbit, porcupine, squirrel, beaver, and panthers for their flesh, skins, sinew, antlers, horns, etc. The lynx, coyote, and other animals were only primarily eaten during times of famine. Marten, mink, fisher, otter, wolverine, black and gray wolves, fox, weasel, and muskrat were sought after for their skins only. Although 100 species of birds are defined in the Lillooet language, they were not a dietary staple (Kennedy and Bouchard 1998).

When a deer was killed, it was butchered at the kill site and generally the oldest hunter would distribute the parts (Teit 1900). The men would carry as much of the meat as possible back to their hunting camp where they processed the skins and dried the meat (Tyhurst 1992:377). The meat was cut into thin slices, and then dried over a smoky fire. Dried meat, dried skins, and conceivably bones or antlers for making tools would have been transported back to the village (Hayden 1997). Teit (1906) observed that a large portion of the dried meat was stored without the bones. The aboriginal Lillooet would have had to limit the amount of meat brought back to the village based on what they or their dogs could carry. Therefore, it seems logical to assume they would have done away with the heavy and cumbersome bones. As a result, determining the importance of mammalian resources, based upon the occurrence of complete or identifiable faunal remains within the archaeological record, is a more difficult endeavor.

Similar to the Keatley Creek site and test excavations at other Lillooet winter village sites (Kusmer 2000, Langemann 1987), the vast majority of mammal bones recovered from the Bridge River site were highly fragmented. This is assumed attributable to the extraction of lipids, which was a subsistence practice Teit (1909) observed within the Lillooet area. Bones were smashed to collect the marrow and to boil the grease from the bones (Hayden 1997).

CHAPTER 3:

RESEARCH METHODS AND DESIGN

EXCAVATION PLANS AND METHODS

The main goal of the 2003 and 2004 Bridge River excavations was to determine when population levels of the village were at their peak and when social inequality developed within the Mid-Fraser region. Formulating a chronology of human occupation for the Bridge River site was the first step in achieving the established research goals. In an effort to enhance the excavator's success in recovering carbon samples for radiocarbon analysis, Dr. William Prentiss made use of innovative ground remote sensing and site-wide geophysical reconnaissance techniques, in addition to traditional archaeological methods.

Prior to the 2003 excavations, a comprehensive metric grid was placed over the site with a north-south baseline. A total station was used to develop a site-wide contour map in order to examine variability in natural and cultural features (Prentiss 2004:4). Prior to the 2004 field season, a geomorphologist performed site-wide electromagnetic conductivity tests in conjunction with soil magnetic assessments. These data were digitally recorded, which allowed the geomorphologist to produced color-contour plans that correlated different colors to varying degrees of spatial variability within the soil (Prentiss 2004). These tests were performed in an effort to connect house floors, storage pits, burials, and other soil-rock features to anomalous conductivity patterns.

Excavations during the 2003 field season focused mainly on hearth features and roasting pits, while almost the entire 2004 field season was dedicated to the excavation of housepits. The 2004 excavation units were positioned in the proximity of the anomalies recorded by the geomorphologist (Figure 3-1). This method of unit placement was utilized in hopes of correlating different archaeological features to the color-coded anomalies recorded by the geomorphologist. This method proved very successful in extracting carbon samples for radiocarbon dating.

Throughout both field seasons, 50 X 50 cm. excavation units were employed. All units were hand excavated with trowels, dustpans, and when necessary smaller excavation tools such as paintbrushes and bamboo sticks. Sediments were excavated according to natural stratigraphic layers and the soil was sifted through 1/8" screens. Lithic and faunal artifacts were collected separately and then placed in plastic bags with the proper provenience information. At Dr. William Prentiss' discretion, one-liter soil samples were taken from housepit floors and *in situ* features for paleoethnobotanical studies. In addition, botanical samples, usually consisting of sizeable pieces of rolled birch bark, were collected for further analysis.

STRATUM LEGEND FOR THE BRIDGE RIVER SITE

Table 3-1 provides a brief description of the stratigraphic layers commonly encountered when performing housepit excavations at the Bridge River site. Occasionally strata II, III, and V are followed by letter designations to indicate a strata may be the same, but contains distinctly different characteristics or is separated by a different strata (Markle and Prentiss 2005:13).

Table 3-1: Stratigraphic Legend for the Bridge River Site (Markle and Prentiss 2005).

Stratum	Description
I	Surface: dark and loosely compact; bioturbation evident; no charcoal; minimal lithic and faunal remains
II	Floor: lightest color of all the sediments and moderately to highly compact; no bioturbation; occasional fire reddening; minimal charcoal; lithics and FCR (Fire Cracked Rock) are moderate to minimal; few faunal remains
III	Rim: Dark grayish sediment and minimally to moderately compact; bioturbation is only present when directly preceded by stratum I; charcoal, FCR, lithics, and faunal remains are abundant
III-1	Floor-like rim
III-2	woody/organic rim
III-3	Roof-like rim; more rocky
IV	Sterile alluvial sediment: very light color silty sand with few clasts; moderate to high level of compactness; no charcoal or faunal remains; minimal FCR and lithics
V	Roof: Dark sediment that is loosely compact; bioturbation is minimal when directly below stratum I; charcoal, FCR, lithics, and faunal fragments are abundant
VIII	Sterile colluvial substrate
XI	Sterile alluvial sediment: very light color and highly compact; high concentration of clasts; no charcoal or faunal remains present; few lithics and FCR attributable to wash in
XII	Redeposited colluvial sediment
XIII-I	External Pit Feature (EPF) rim: Distinctly gray sediment that is very loose silty sand; high rock concentration; minimal amounts of charcoal, faunal, and lithic remains; moderate amounts of FCR; only found in Housepit 31

RADIOCARBON DATING

When applicable, carbon samples were collected from housepit floors, *in situ* features, and collapsed roof beams. These samples were sent to the University of Arizona for AMS dating. The radiocarbon dates obtained during the 2003 and 2004 excavations of the Bridge River Site are essential to identifying various occupations. Furthermore, faunal remains from dated contexts are crucial to the understanding of past predation practices in relation to the environmental conditions present at the time the Bridge River Site was occupied.

Radiocarbon dates obtained during the excavations of the Bridge River site were divided into four distinct occupations (Markle and Prentiss 2005). The four occupations are as follows: Bridge River 1 (1864-1696 B.P.), Bridge River 2 (1646-1414 B.P.), Bridge River 3 (1375-1139 B.P.), and Bridge River 4 (638-167 B.P.).

CUBIC METERS EXCAVATED FOR EACH OCCUPATION

Different amounts of soil were excavated for each occupation. In order to establish a ratio between the quantity of mammal and osteichthyes remains in relation to the total amount of cubic meters excavated for each occupation, it was necessary to estimate the cubic meters of excavated soils for each datable housepit stratum. Table 3-2, located within the Appendix, provides a complete list of the number of cubic meters excavated for each housepit, housepit size, and occupation. The total number of cubic meters excavated for each occupation is presented in Table 3-3. Table 3-4 represents the total number of cubic meters excavated from medium and large size housepits. Medium sized housepits (M) range in size from 9.5-14.5 meters and large sized housepits (L) are larger then 14.6 meters in diameter.

Table 3-3: Number of Cubic Meters Excavated for Each Occupation.

Phase of Occupation	Cubic Meters
Bridge River 1 (1864-1696 BP)	$0.575m^3$
Bridge River 2 (1646-1414 BP)	$1.11m^3$
Bridge River 3 (1375-1139 BP)	$2.5125m^3$
Bridge River 4 (638-167 BP)	$.9375m^3$

Table 3-4: Number of Cubic Meters Excavated from Medium and Large Sized Housepits.

Phase of Occupation	Housepit Size: Medium	Housepit Size: Large
Bridge River 1	$0.4125m^3$	$0.1625m^3$
Bridge River 2	$0.63m^3$	$0.48m^3$
Bridge River 3	$2.0425m^3$	$.047m^3$
Bridge River 4	$0.615m^3$	$0.3225m^3$

Error should be .47

ANALYTICAL METHODS

The Applicability of Zooarchaeological Analysis

Thomas (1996) defines zooarchaeology as "the study of the past interactions between people and animals, usually involving the analysis and interpretation of animal remains from archaeological deposits but sometimes using additional data sets, such as art representations, documentary sources, etc." Understanding how humans interacted with their environment, and more specifically with animal populations, is one of the main tenets of zooarchaeology. The exploration of change within human societies is also a frequent component of zooarchaeological research (Reitz and Wing 1999). Since research at the Bridge River site examines changes in subsistence strategies over time in relation to environmental reconstructions for the Mid Fraser region, zooarchaeological analysis of recovered faunal remains is pertinent.

Specific Analyses

The Bridge River faunal assemblage was subjected to several different taphonomic analyses to determine if cultural or non-cultural factors had significantly compromised its ability to attest to the predation strategies of past tenants. The methods for identifying and quantifying bone weathering, heat treatment of bones, bone breakage and butchery, and other taphonomic processes are discussed below.

Bone Weathering

Weathering is "the process by which the original microscopic organic and inorganic components of a bone are separated from each other and destroyed by physical and chemical agents operating on the bone in situ, either on the surface or within the soil zone" (Behrensmeyer 1978). The degree of bone weathering can affect the results of taxonomic analysis. The more weathered a bone the less taxonomic information can be obtained. The degree of bone weathering was separated into five categories based upon criteria given in Behrensmeyer (1978).

Table 3-5: Weathering Stages.

Stage	Diagnostic Criteria
0	The bone surface shows no cracking or flaking.
1	The bone surface shows cracking, usually parallel to the orientation of collagen fibers. Articular surfaces may show cracking in a mosaic pattern.
2	Bone surfaces show flaking, usually along the edges of cracks. Crack edges are angular, with no rounding.
3	Bone surfaces show roughened patches resulting from the flaking of surface bone, but only to a depth of 1.0-1.5 mm. Crack edges are typically rounded.
4	Bone surfaces are rough, with loose splinters. Cracks are wide, with rounded or actively splintered edges.
5	The bone is disintegrating into splinters, and the original shape may no longer be apparent.

(Table adapted from Orcholl, Dietz, and Prentiss 2004)

Heat Treatment

Another component of the taphonomic analysis was to measure the degree to which bones had been heat modified. Burning from excessive heat can modify or damage bones, regardless if the exposure is extensive or temporary (Lyman 1994). Brain (1981) has determined that there are two distinct stages in the charring of bone. In the first stage, the bone turns black and as the carbon is oxidized the bone exhibits a white color and chalky texture.

According to Shipman et al. (1984) a bone's color may be used to indicate the range of temperatures to which a bone has been exposed, if external factors have not affected the bone's color and it is clear it has been heat modified. Table 3-6, which has been adopted from Lyman (1994), provides a summary of the changes bones undergo as they are exposed to heat. Table 3-7 correlates the colors adherent to different degrees of heat treatment to five numerical stages.

Table 3-6: Summary of Changes to Bone Subjected to Heating (Lyman 1994).

```
Heat Source |----|grass fire----------------|camp fire-------------|--------|Cremation pyres-→
                  (> 65 Celsius, <6 minutes)

Structure   |--hydroxyapatite---------|cracking--------------|larger crystal size-----------→

Color       |--yellowish---------|red-brown---------|black--|gray-white------------|white→

Degrees     |--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
Celsius     0       100      200      300      400      500      600      700      800      900     1000
```

(Table adapted from Burns and Prentiss 2002)

Table 3-7: Table of Heat Modification Stages for Bone Modified from Lyman (1994).

Stage	Diagnostic Criteria
0	The bone surface shows no heat modification
1	The bone surface shows a yellowish color
2	The bone surface is red-brown color
3	The bone surface is black
4	The bone surface is grey-white
5	The bone is white throughout

(Table adapted from Orcholl, Dietz, and Prentiss 2004)

Bone Size, Breakage, and Butchery

The butchering of an animal carcass may arguably be one of the most destructive taphonomic agents to affect and influence a faunal assemblage, and subsequently comprehensive zooarchaeological analyses. Lyman (1994) defines butchering as "the human reduction and modification of an animal carcass into consumable parts." Cut marks, evidence of chopping, the portions of broken bones present, and the extent and size of bone fragmentation are all indicators of butchery.

General Taphonomy

Root etching, animal gnaw marks, crushing, and abrasions are additional taphonomic processes that may affect the preservation and quality of a faunal assemblage. Many plant roots excrete humic acid during periods of growth and decay, and can form dendritic patters of shallow grooves on bone surfaces when they come into contact for an extended period of time (Lyman 1994). Animal gnaw marks can mimic or mask human butchering activities so it is important to accurately identify, record, and evaluate a faunal assemblage for this taphonomic process. Crushing, abrasions, and polishing are additional taphonomic processes, which may inhibit comprehensive zooarchaeological analyses.

LABORATORY METHODS

All of the faunal remains were taphonomically analyzed and when applicable were compared to the faunal collections located in the Zooarchaeology Laboratory at Simon Fraser University. Debbi Yee Cannon's (1987) *Marine Fish Osteology*, B. Miles Gilbert's (1990) *Mammalian Osteology*, and B. Miles Gilbert's (1990) *Avian Osteology* were also used for comparative identification in an effort to discern taxonomic genera and skeletal element. When pertinent, the age of the bone was recorded. It was impossible to determine the sex of mammal remains given the fragmentary condition and size of the bones. The class, genera, and element of each bone was recorded when possible. Faunal remains were examined for cut marks, abrasions, gnaw marks, polishing, root etching, crushing, and fractures. Weathering and heat modification were recorded and measured by criteria given in Behrensmeyer (1978) and Lyman (1994). The weight in grams for faunal remains was recorded, as well as the size of individual bones in relation to one-centimeter intervals. A digital sliding caliper was used to attain precise measurements for the few bones larger then six centimeters.

Subsequently, the faunal data was entered into an Access 2000 database, which allows for the manipulation and analysis of specific data sets. Osteichthyes and mammal remains were separated based upon housepit designation, subsquare, square, stratum, level, and when applicable feature and quadrant. Radiocarbon dates associated with the four occupations were entered into the database according to the corresponding housepit strata. The database allows me to assess variation in fauna for each occupation in an effort to ascertain if past tenants of the Bridge River site relied on a salmon-dominated or mammalian-dominated subsistence strategy throughout the history of the village.

OPTIMAL FORAGING THEORY

This section provides a short synopsis of the Diet Breadth model, which will be used to interpret the Bridge River faunal data (Madsen and Schmitt 1998; Steven and Krebs 1986). The Diet Breadth Model is a variant of the Optimal Foraging Theory, which was originally incorporated into anthropology via biology (Bettinger 1991). Optimal Foraging Theory has been used to explain an assortment of behavioral traits including differential transport, field processing, differences in resource utilization, and the transition to agriculture (Madsen and Schmitt 1998).

To effectively apply the Diet Breadth Model to a data set, all prey utilized by a population must first be ranked to assess the profitability of various prey. Prey ranks are defined as, "a ratio of the net value gained by acquiring a prey item, on the one hand, to the time costs of pursuing and processing the prey once it has been encountered, on the other hand" (Broughton 1994). The Diet Breadth Model predicts that higher ranked prey will be sought after due to their high caloric value and superior energy return rate in comparison to lower ranked prey. Moreover, lower ranked prey are added to the diet when the search costs for higher ranked prey increases, and the cost of exclusively pursuing and processing the higher ranked prey is maladaptive. Generally, prey are ranked according to body size, which is usually the only proxy measure of prey rank currently available to archaeologists (Broughton 1994). Other values such as hide, fur, bones or tools, and prestige may also have been important (Janetski 1987).

The Diet Breadth Model can allow archaeologists to infer if resource intensification transpired based upon the proportion of high and low ranked resources within a faunal assemblage. Resource intensification is a cultural process, which results in the increased subsistence return per unit of land or labor. Intensification occurs when a population has an increased ability to mass harvest. In general, "when the abundance of many lower ranked resources increases, particularly mass collected resources, so too does their ranking in the diet as they become higher ranked prey types. It follows then, that higher ranked food types can be displaced from the diet with no change in their actual abundance" (Madsen and Schmitt 1998). Resource intensification can also occur when the "total productivity per areal unit of land is increased at the expense of an overall decrease in foraging efficiency" (Broughton 1994).

The mass collection of salmon within the Mid-Fraser region is a factor influencing prey rank. The Diet Breadth or prey choice model assumes that prey are encountered and acquired one at a time (Broughton 1994). However, mass collection techniques do not follow this line of logic, and could potentially disrupt the contention that body size equals prey rank (Janetski 1997). Madsen and Schmitt (1998) convincingly argue that the techniques or technologies used for mass collection in addition to population density must be taken into account.

Salmon are the number one ranked food source within the Mid-Fraser region (Kusmer 2000a). This is in large part due to the density and predictability of salmon, in addition to technological innovations (i.e. nets and weirs) for mass collection. According to the Diet Breadth Model, salmon remains should constitute the majority of the Bridge River faunal assemblage.

CHAPTER FOUR

RESULTS

This chapter presents the faunal data collected during the 2003 and 2004 Bridge River field seasons, based upon their occupational sequence (Tables 4-1 to 4-4). A taphonomic analysis of the Bridge River faunal assemblage is presented to identify and explain possible impacts on accurate zooarchaeological research. This chapter also includes an element survivorship analysis of salmon remains, to show that cultural interpretations are real and not the byproduct of varying degrees of preservation. The NISP for each occupation were used to calculate richness and evenness. This was done in an attempt to discern if there were changes in predation spectrum or mode (Chatters 1987) during the history of the Bridge River village.

Table 4-1: Identified Mammal and Osteichthyes Species and Elements: Occupation 1.

Unit	Sq.	Ssq.	Stratum	Level	Identification	Elements	NISP
25	B	12	V-A	2	*Odocoileus* sp.	long bone epiphysis/2	2
						left tibia	1
9	A	9	II	7	*Oncorhynchus* sp.	coracoid	1
						ribs/spines/4	4
						basipterigium	1
						basioccipital	1
						caudal vertebrae/3	3
						vertebra	1
						hyomandibular/2	2
						scapula	1
						vertebrae fragments/12	12
						unidentified elements/19	19
25	B	12	II-A	1		vertebrae fragments/2	2
						basipterigium	1
25	B	12	II-A	3		vertebra	1
						vertebra fragment	1
25	B	12	V-A	2		vertebra	1
						vertebrae fragments/4	4
26	B	2	II-C	1		caudal vertebrae/37	37
						thoracic vertebrae/6	6
						ribs/spines/19	19

						unidentified elements/3	3
						vertebrae fragments/26	26
						vertebrae/24	24
26	B	2	II-C	2		thoracic vertebrae/4	4
						caudal vertebrae/8	8
						vertebrae/2	2
						vertebrae fragments/62	62
						unidentified fragments/25	25
						rib/spines/5	5
26	B	2	II-C F-2	2		caudal vertebra	1
						vertebrae/6	6
						unidentified fragments/3	3
38	B	1	II-A	1		caudal vertebrae/2	2
						vertebrae fragments/3	3
						rib/spine	1
						unidentified fragments/4	4
38	B	1	II-A	2		vertebrae fragments/4	4
						unidentified fragments/4	4
38	B	1	II-A	3		thoracic vertebra	1
						vertebrae fragments/3	3
						unidentified fragments/3	3
						rib/spine	1
38	B	1	II-A	4		thoracic vertebra	1
38	B	1	II-A F-2	1		caudal vertebra	1
						rib/spine	1
38	B	1	III-A	1		thoracic vertebra	1
						TOTAL NISP	**319**

Table 4-2: Identified Mammal and Osteichthyes Species and Elements: Occupation 2.

Unit	Sq.	Ssq.	Stratum	Level	Identification	Elements	NISP
35	A	4	II	6	*Canis familiaris*	rib	1
23	A	13	V-B	1	*Castor canadensis*	incisor	1
3	A	10	II-A	11	*Odocoileus* sp.	left radius, distal end	1
3	A	10	II-A	12		right radius, distal end	1
11	A	3	II-A	1	*Oncorhynchus* sp.	vertebra	1
						caudal vertebra	1
11	A	3	II-A	2		vertebra fragment	1
						vertebra	1
						thoracic vertebra	1
11	A	3	III	1		vertebra fragment	1
						caudal vertebra	1
						precaudal vertebra	1

23	A	13	V	2	thoracic vertebra	1
					caudal vertebra	1
					vertebrae fragments/14	14
23	A	13	II	1	vertebra	1
					vertebrae fragments/5	5
					unidentified elements/4	4
23	A	13	II	2	vertebrae fragments/7	7
					rib/spines/4	4
					precaudal vertebrae/2	2
					thoracic vertebra	1
					caudal vertebra	1
					unidentified elements/3	3
23	A	13	V-A	1	vertebrae fragments/6	6
					thoracic vertebra	1
					unidentified fragments/3	3
23	A	13	II-A	1	rib/spine	1
23	A	13	II-A	2	vertebrae/2	2
					thoracic vertebra	1
23	A	13	V-B	1	vertebrae fragments/5	5
23	A	13	II-B	1	caudal vertebra	1
					unidentified fragments/9	9
23	A	13	II-C	2	vertebra fragment	1
					unidentified fragment	1
23	A	13	II-C	3	rib/spine	1
					unidentified fragment	1
23	A	13	II-C	4	rib/spine	1
					vertebrae/5	5
					vertebra fragment	1
23	A	13	II-C	5	precaudal vertebra	1
					caudal vertebrae/9	9
					vertebrae/5	5
					rib/spines/5	5
					vertebrae fragments/26	26
					thoracic vertebra	1
					unidentified elements/11	11
23	A	13	II-C	6	rib/spines/16	16
					unidentified fragments/8	8
					caudal vertebrae/7	7
					vertebrae fragments/12	12
					thoracic vertebrae/6	6
					precaudal vertebra	1
					subopercle	1
23	A	13	II-C F-1	1	vertebra fragment	1

23	A	13	II-C F-1	2		vertebrae/4	4
						vertebrae fragments/4	4
26	B	2	II-A	1		caudal vertebra	1
						rib/spine	1
35	A	4	II	6		thoracic vertebrae/5	5
						caudal vertebrae/3	3
						basipterigium	1
						vertebra fragment	1
						unidentified fragment	1
54	A	10	II-E F-6	2		thoracic vertebra	1
						unidentified fragment	1
78	A	4	II	1		caudal vertebra	1
						vertebra	1
						unidentified fragments/3	3
78	A	4	II	2		vertebrae fragments/3	3
						rib/spine/1	1
						unidentified fragment/1	1
78	A	4	II F-1			rib/spine	1
23	A	13	II-C	1	*Sciurus carolinensis*	left mandible with tooth	1
						TOTAL NISP	**241**

Table 4-3: Identified Mammal and Osteichthyes Species and Elements: Occupation 3.

Unit	Sq.	Ssq.	Stratum	Level	Identification	Elements	NISP
12	A	16	III	1	*Canidae*	tooth	1
54	A	10	II-A F-2	2	*Canis familiaris*	mandibular molar tooth	1
24	B	10	II-A	1	*Felidae*	tooth	1
3	A	10	V-A	2	*Odocoileus* sp.	left metatarsal, distal end	1
12	A	16	II	5		phalange	1
16	A	4	II	3		phalange	1
37	A	14	V	2		metapodial, distal end	1
54	A	10	II-C	1		tooth fragments/6	6
						jaw fragments/4	4
1	A	12	V-B	1	*Oncorhynchus* sp.	vertebrae fragments/5	5
1	A	12	II-IV	2		vertebra	1
12	A	16	II	2		thoracic vertebra	1
						vertebrae/2	2
12	A	16	II	3		vertebra	1
						caudal vertebrae/2	2
						vertebra fragment	1
12	A	16	II	4		vertebra fragment	1
12	A	16	II	5		precaudal vertebra	1
						vertebra fragments/2	2
						unidentified elements/2	2
12	A	16	II	6		vertebrae fragments/16	16
						caudal vertebra	1

					thoracic vertebra	1
					rib/spines/2	2
12	A	16	V	2	vertebra	1
					unidentified element	1
12	A	16	III	1	vertebra	1
16	A	4	II	1	vertebrae fragments/7	7
					caudal vertebra	1
16	A	4	II	2	vertebrae fragments/2	2
					vertebra	1
16	A	4	II	3	vertebra	1
					thoracic vertebra	1
					rib/spines/9	9
					vertebrae fragments/6	6
					unidentified elements/4	4
16	A	4	II	4	rib/spine fragments/37	37
					vertebrae fragments/18	18
					unidentified fragment	1
16	A	4	II	5	coracoids/2	2
					basipterigium/3	3
					caudal vertebrae/2	2
					rib/spines/164	164
					precaudal vertebra	1
					vertebrae/5	5
					vertebrae fragments/23	23
					unidentified fragments/57	57
					lower postcleithrum	1
16	A	4	II	6	rib/spines/66	66
					thoracic vertebrae/2	2
					scapula	1
					basipterigium	1
					unidentified fragments/6	6
					vertebrae fragments/6	6
					caudal vertebrae/2	2
					vertebrae/8	8
16	A	4	II	7	rib/spines/2	2
					vertebra fragment	1
					unidentified fragments/2	2
16	A	4	II F-1	6	unidentified fragment	1
					rib/spines/51	51
24	B	10	II-A	1	vertebrae fragments/12	12
					caudal vertebrae/3	3
					rib/spine	1
					thoracic vertebrae/2	2
					vertebra	1
					unidentified fragments/3	3
24	B	10	II-A	2	thoracic vertebra	1
					vertebrae/2	2

						vertebrae fragments/7	7
						unidentified fragments/5	5
33	A	10	II-A	3		unidentified fragment	1
						rib/spines/2	2
33	A	10	II-A	4		vertebra	1
37	A	14	V	1		vertebra fragment	1
39	A	1	V-A	1		caudal vertebrae/5	5
						thoracic vertebra	1
						vertebra	1
						vertebrae fragments/12	12
51	A	13	II-A	1		vertebrae fragment/3	3
						rib/spine	1
54	A	10	II-C	1		rib/spines/2	2
54	A	10	II-C	2		caudal vertebra	1
54	A	10	II-C	3		vertebrae fragments/8	8
						caudal vertebrae/4	4
						thoracic vertebra	1
						unidentified fragment	1
54	A	10	II-C	4		thoracic vertebrae/5	5
						vertebrae/35	35
						vertebrae fragments/9	9
						caudal vertebra	1
54	A	10	II-D F-4	5		vertebrae fragments/5	5
54	A	10	II-D F-4	6		vertebra fragment	1
54	A	10	II-D F-5	1		vertebra	1
61	A	1	III	1		vertebra fragment	1
61	A	1	III	2		vertebrae fragment/9	9
						rib/spines/2	2
61	A	1	III	4		thoracic vertebra	1
						vertebrae/3	3
						unidentified fragment	1
61	A	1	III	5		vertebrae fragment/4	4
						thoracic vertebra	1
						rib/spine	1
						basipterigium	1
						unidentified fragments/7	7
61	A	1	II-B F-1	1		vertebra fragment	1
						unidentified fragment	1
						TOTAL NISP	**726**

Table 4-4: Identified Mammal and Osteichthyes Species and Elements: Occupation 4

Unit	Sq.	Ssq.	Stratum	Level	Identification	Elements	NISP
8	A	14	II	1	*Odocoileus* sp.	long bone fragments/3	3
						phalanx	1
20	A	11	F-4	1		left hind III	1
8	A	14	II	1	*Oncorhynchus* sp.	vertebrae fragments/26	26

8	A	14	II	2	vertebrae fragments/2	2
8	A	14	V-A	2	unidentified fragments/3	3
34	A	13	III	1	rib/spines/2	2
					unidentified fragments/5	5
					basipterigium/2	2
34	A	13	III	2	thoracic vertebrae/8	8
					caudal vertebrae/6	6
					vertebrae/5	5
					vertebrae fragments/8	8
					unidentified fragments/68	68
					rib/spines/37	37
					dentary	1
					basipterigium/2	2
34	A	13	III	3	rib/spines/70	70
					caudal vertebrae/10	10
					unidentified fragments/77	77
					basioccipital (atlas)	1
					supraoccipital	1
					thoracic vertebrae/4	4
					vertebrae fragments/40	40
					basipterigium/2	2
					dentary fragment	1
					scapula	1
					precaudal vertebra	1
					ceratobranchial	1
					quadrate/2	2
					hypohyal	1
34	A	13	III	4	caudal vertebrae/28	28
					thoracic vertebrae/3	3
					vertebrae/15	15
					vertebrae fragments/22	22
					precaudal vertebra	1
					rib/spines/74	74
					unidentified fragments/64	64
					symplectic	1
					pectoral girdle cleithrum	1
34	A	13	III	5	rib/spines/56	56
					unidentified fragments/13	13
34	A	13	III	6	vertebrae fragments/27	27
					unidentified fragments/62	62
					caudal vertebrae/12	12
					precaudal vertebrae/3	3
					thoracic vertebrae/6	6
					pectoral girdle	1

					rib/spines/43	43
					posttemporal/2	2
					epihyal	1
					vertebrae/6	6
34	A	13	III	7	caudal vertebrae/11	11
					rib/spines/23	23
					dentary/2	2
					unidentified fragments/37	37
					vertebrae/7	7
					thoracic vertebrae/2	2
					pelvic girdle	1
					basipterigium/2	2
					vertebrae fragments/29	29
34	A	13	III	8	caudal vertebra	1
					vertebrae fragments/8	8
					vertebrae/2	2
					rib/spines/7	7
					unidentified fragments/8	8
34	A	13	II	1	caudal vertebra	1
					rib/spines/3	3
					vertebra	1
					unidentified fragment	1
34	A	13	IV	1	rib/spine	1
					unidentified fragment	1
57	B	3	III-B	2	caudal vertebra	1
					TOTAL NISP	**982**

IMPLICATIONS OF TAPHONOMIC ANALYSES

Bone Weathering

Figures 4-1 and 4-2 show the degree of weathering present within the Bridge River faunal assemblage. Overall, taphonomic analyses of the bones recovered from the Bridge River site indicate excellent site preservation. Only 12% of the total assemblage exhibits bone weathering, and of these bones, less than 3% exhibit more than stage two weathering. Perhaps the most noteworthy aspect of bone weathering is illustrated in Figure 4-2, which clearly indicates that the older specimens are less weathered. This aspect of site preservation is significant because it indicates there has been little disturbance throughout the history of the site, and the older components were covered and thus protected from the elements by overlying soil layers.

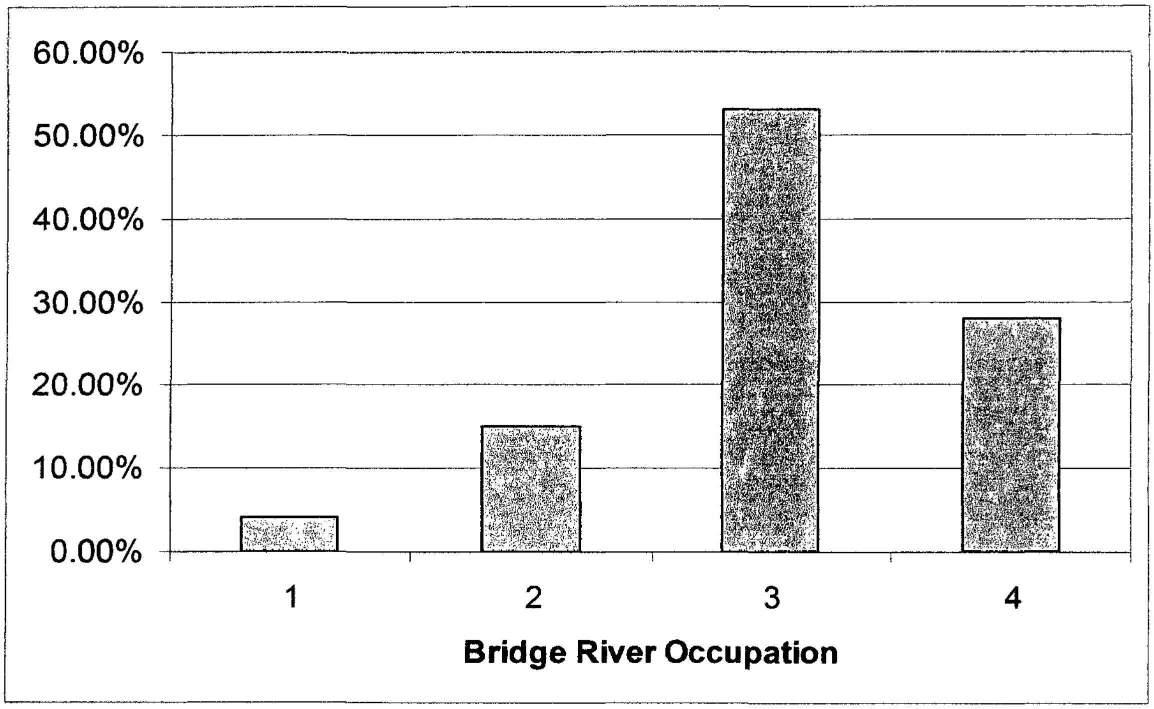

Figure 4-1: Percentage of Weathered Mammal and Osteichthyes Faunal Remains.

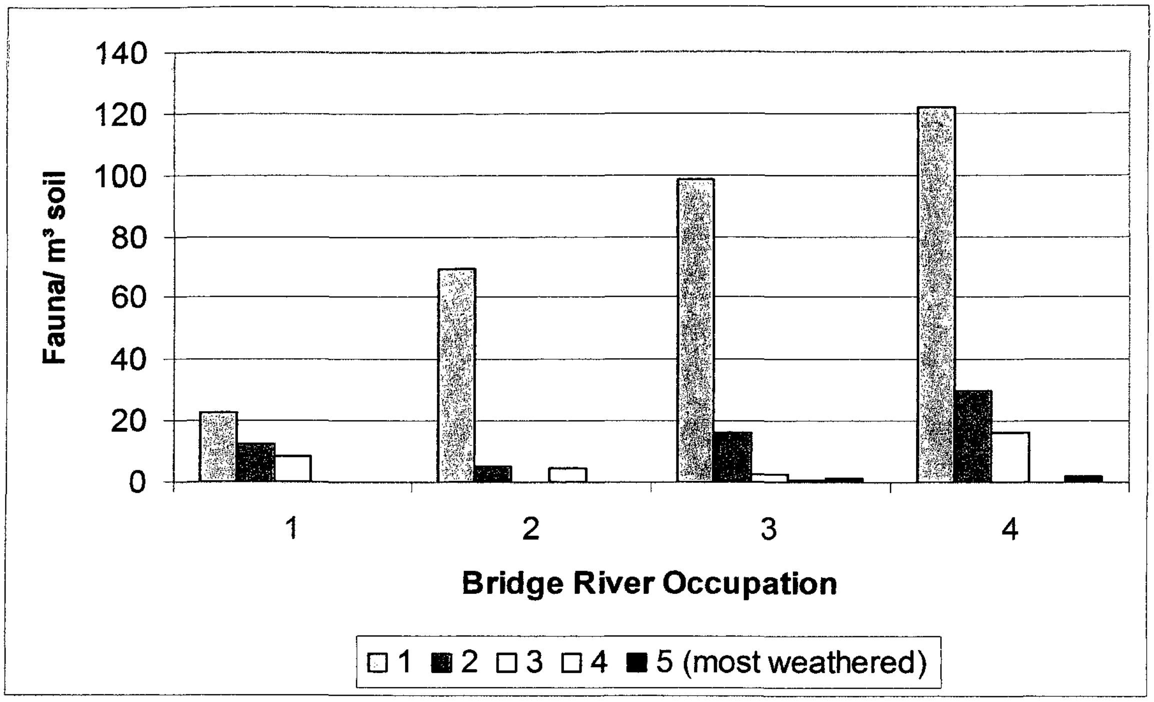

Figure 4-2: The Degree of Weathering Exhibited by Mammal and Osteichthyes Remains Depicted as a Ratio to the Number of Cubic Meters Excavated for Each Occupation.

Heat Treatment

The degree to which bones have been heat modified can potentially hamper accurate zooarchaeological analyses, so it is important to assess the impact of burning activities on the Bridge River faunal assemblage. Figures 4-3 and 4-4 illustrate the extent and intensity of heat treatment for each occupation of the Bridge River village.

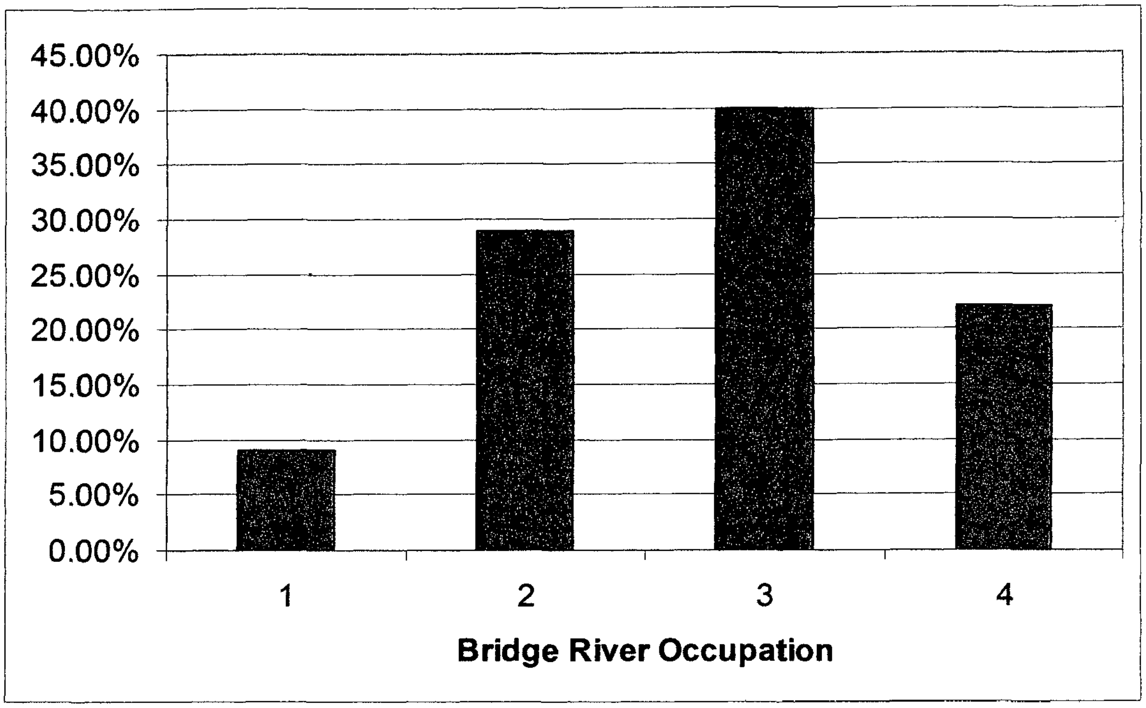

Figure 4-3: Percentage of Heat Treated Mammal and Osteichthyes Remains.

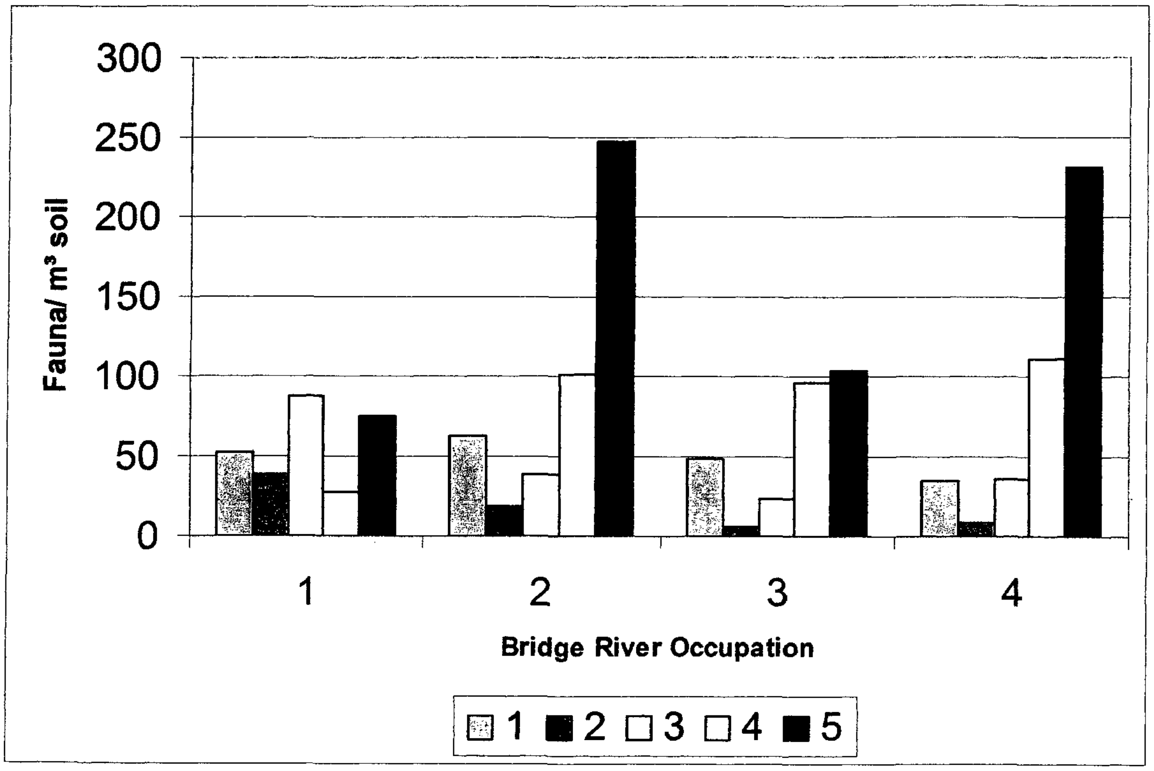

Figure 4-4: The Degree of Heat Treated Mammal and Osteichthyes Remains Depicted as a Ratio to the Number of Cubic Meters Excavated for Each Occupation.

Thirty-eight percent of the Bridge River faunal remains have been heat-treated and of these bones, 71% exhibit characteristics of stage four and stage five burning. Practically none of the osteichthyes remains have been heat-treated, which indicates they were most likely open-air dried, rather then cooked. Burns (2003) observed a similar pattern when analyzing the Keatley Creek Housepit 7 faunal assemblage. She noticed mammal remains constituted the majority of the heat-treated bones, and that most of these remains had been subjected to intensive heat. When the degree of heat-treated bones are viewed as a ratio to the number of cubic meters excavated for each occupation, Bridge River occupations 2 and 4 exhibit more heat-treated bones, especially bones exhibiting stage 5 burning. This inference is logical because during these occupations there were more mammal remains recovered in relation to the number of cubic meters excavated for each occupation.

Bone Size, Breakage, and Butchery

The size of the bones present within the Bridge River faunal assemblage definitely affects the potential for comprehensive zooarchaeological analyses, including the ability to identify a particular taxon, species, or element. Breakage and butchery patterns can also make it difficult to perform zooarchaeological analyses, but they can also attest to the cultural practices of the past tenants of the Bridge River village. Figure 4-5 and 4-6 depicts the size of the faunal remains recovered for each occupation.

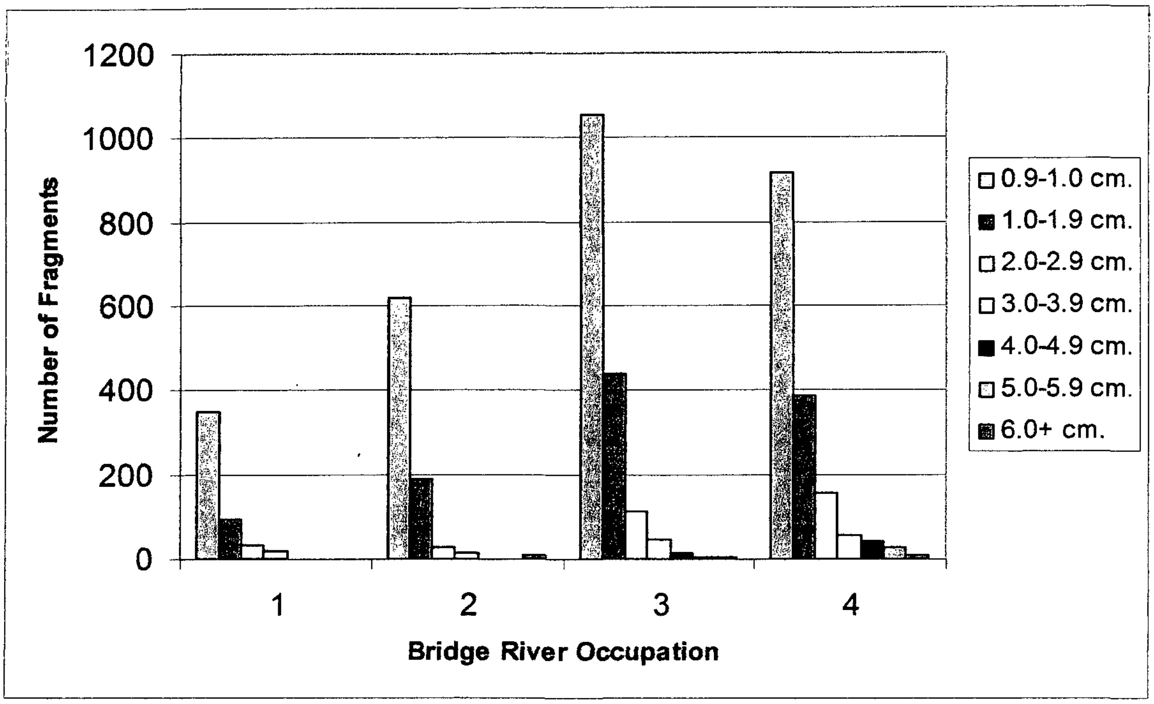

Figure 4-5: Bone Size Ranges in Centimeters.

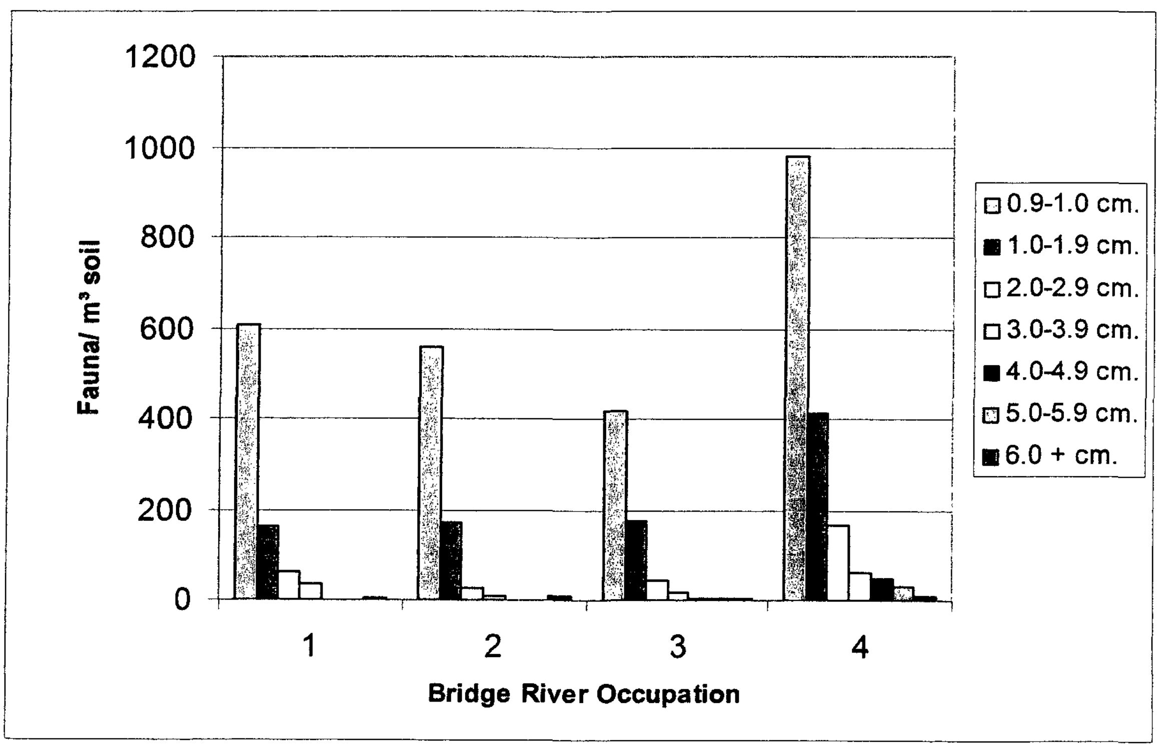

Figure 4-6: The Size of Mammal and Osteichthyes Remains Depicted as a Ratio to the Number of Dated Cubic Meters Excavated for Each Occupation.

Only 13% of the mammal and osteichthyes bones recovered from the Bridge River site are more than two centimeters in length, which is most likely attributable to bone fracturing and the small size of osteichthyes remains. Osteichthyes fragments, predominately consisting of *Oncorhynchus* sp. remains, make-up fifty-one percent of the bones analyzed. The elevated quantity of bone fragmentation exhibited during Bridge River 4 directly correlates with a substantial increase in osteichthyes remains.

Another factor contributing to the high degree of bone fragmentation present within the faunal assemblage was the extraction and utilization of mammal bone marrow and grease. Animal skeletons are a good source of fat, and by a ratio of 9:4 possess a higher caloric value than either protein or carbohydrates (Outram 2001). Similar to the mammal remains recovered from the Bridge River site, Burns (2003) and Kusmer (2000) observed high instances of bone fragmentation present within the mammal remains recovered from the Keatley Creek site. Langemann (1987) also found mammal bones recovered from several Mid-Fraser villages to be extremely fragmented. According to Binford (1978), the extraction of bone marrow and grease exploitation among the Nunamuit was performed during periods of subsistence stress. He also observed that bone fat was used for craft and industrial projects such as tanning hides, waterproofing skins, and treating bowstrings. The high degree of fragmentation present within the faunal assemblages recovered from the Bridge River and Keatley Creek sites suggests past tenants of the Mid-Fraser region may have regularly experienced subsistence stress or valued bone marrow and grease for craft or industrial endeavors.

Few of the mammal remains recovered from the Bridge River site exhibit cut marks or evidence that they have been chopped, which again is most likely attributable to the fragmented state of the assemblage. However, the mammal bones that had been chopped almost exclusively exhibit spiral fractures. Kusmer (2000) also observed spiral fractures to be the most common breakage type found at the Keatley Creek site. Spiral fractures are typical of classic fresh or green-bone breaks (Outram 2001). Furthermore, bone breakage was determined to have been the result of human reduction activities as the fractures occurred on the mid-shaft region and not the bone ends. The spiral fractures observed on the bones recovered from the Bridge River site were also located on the mid-shaft regions.

General Taphonomy

Other taphonomic process such as crushing, root etching, abrasions can affect the quality of zooarchaeological analyses. Figure 4-7 shows the effects of taphonomic processes on the Bridge River faunal assemblage for each occupation.

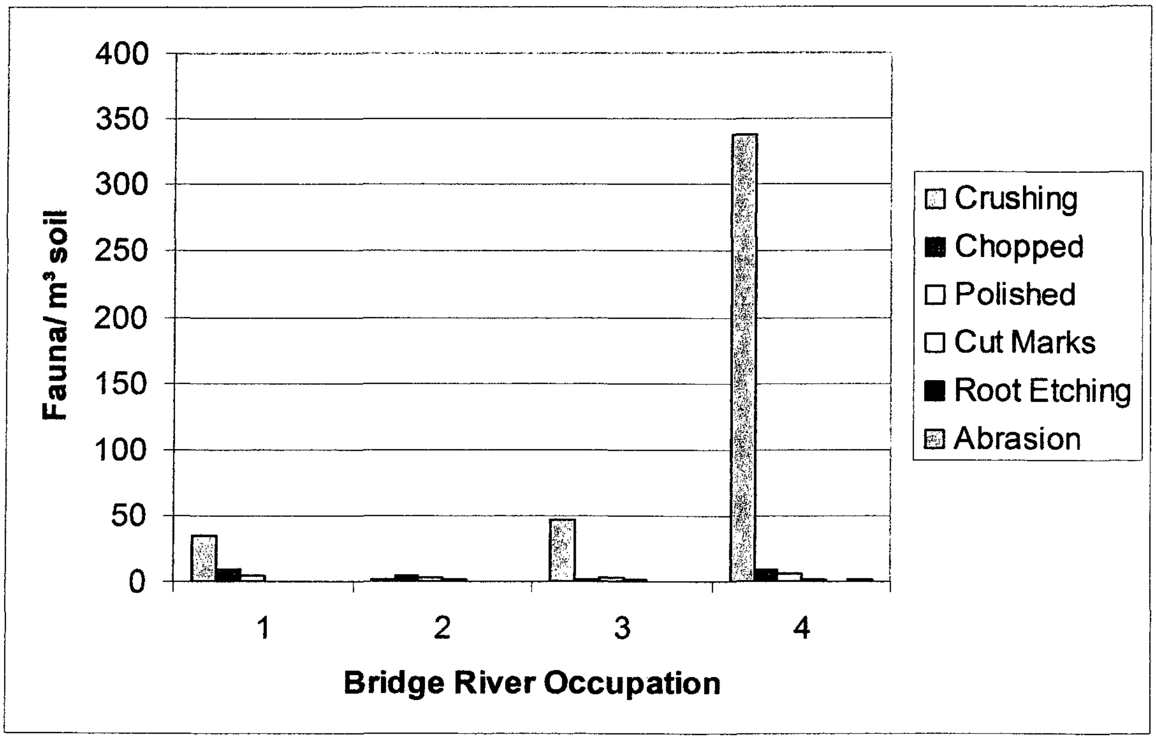

Figure 4-7: Bone Modification Depicted as a Ratio to the Number of Dated Cubic Meters Excavated for Each Occupation.

Overall, the degree of bone crushing appears to increase throughout the occupational history of the Bridge River site. The stratigraphic layers associated with Bridge River 4 would have been closer to the ground surface, and therefore may have been more susceptible to taphonomic processes, such as crushing. This is also evidenced by the increase in bone weathering throughout the occupational history of the site. Bridge River 4 contains more osteichthyes remains than any other occupation. Generally, osteichthyes remains are more fragile, which may explain the increase in the frequency of crushed bones. The presence of polishing, cut marks, root etching, and abrasions are minimal and there is no evidence of animal gnaw marks on any of the bones.

Zooarchaeological Analyses

Probably the most influential taphonomic process influencing zooarchaeological analyses was the intensity of bone fragmentation observed throughout the occupational history of the site. Smaller fragments are less likely to be identified to species or element. The degree of bone weathering was minimal and the number of heat-treated bones was primarily limited to mammalian remains. Although many of the mammal remains were heat-treated, they were still able to provide information regarding food processing and consumption practices of the past tenants of the Bridge River site. Overall, the Bridge River faunal assemblage exhibited excellent preservation and taphonomic processes affecting accurate zooarchaeological analyses were minimal.

FAUNAL DATA

Figure 4-8 represents the number of osteichthyes and mammal remains, identified to taxon, recovered from each Bridge River occupation. Figure 4-9 illustrates the quantity of osteichthyes and mammal remains, identified to taxon, recovered in relation to the number of cubic meters excavated for each occupation. During Bridge River 1, 63% of the remains were osteichthyes and 37% were mammalian in origin. There were 316 osteichthyes remains and 185 mammal remains recovered from this occupation. The number of osteichthyes remains (549.57) per one cubic meter of soil is almost double the number of mammal remains (321.74) per m^3. Almost 71% of the remains recovered from Bridge River 2 were mammalian with 551.35 mammal remains per m^3 compared to 225.23 osteichthyes remains per m^3. Fifty-eight percent of the faunal remains recovered from Bridge River 3 were mammalian. Bridge River 3 produced the most faunal remains, with 969 mammal and 713 osteichthyes, which is logical considering that this is when the population levels of the village were highest. However, when the amount of mammal and osteichthyes remains are calculated as a ratio to the number of cubic meters excavated for this occupation they are more consistent with the first two occupations. There were 385.67 mammal remains per m^3 compared to 283.78 osteichthyes remains per m^3. The faunal data, identified to taxon, does indicate a significant reliance on salmon resources during Bridge River 4, with 63% of the remains osteichthyes in origin. Furthermore, when the amount of osteichthyes remains are calculated by m^3 excavated for this occupation the sum of osteichthyes remains are double that of the other three Bridge River occupations. Overall, the faunal data identified to taxon does exhibit fluctuations in the number of mammal and osteichthyes remains recovered for each occupation.

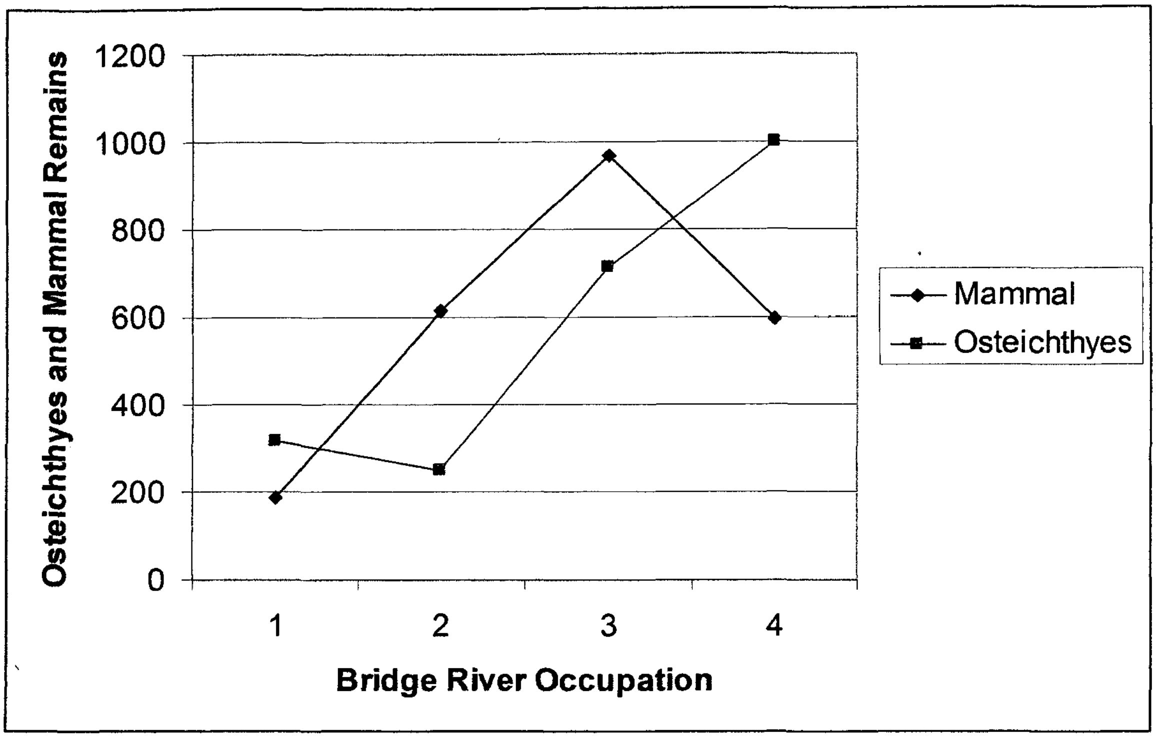

Figure 4-8: Osteichthyes and Mammal Remains, Identified to Taxon, Excavated from Dated Housepit Strata.

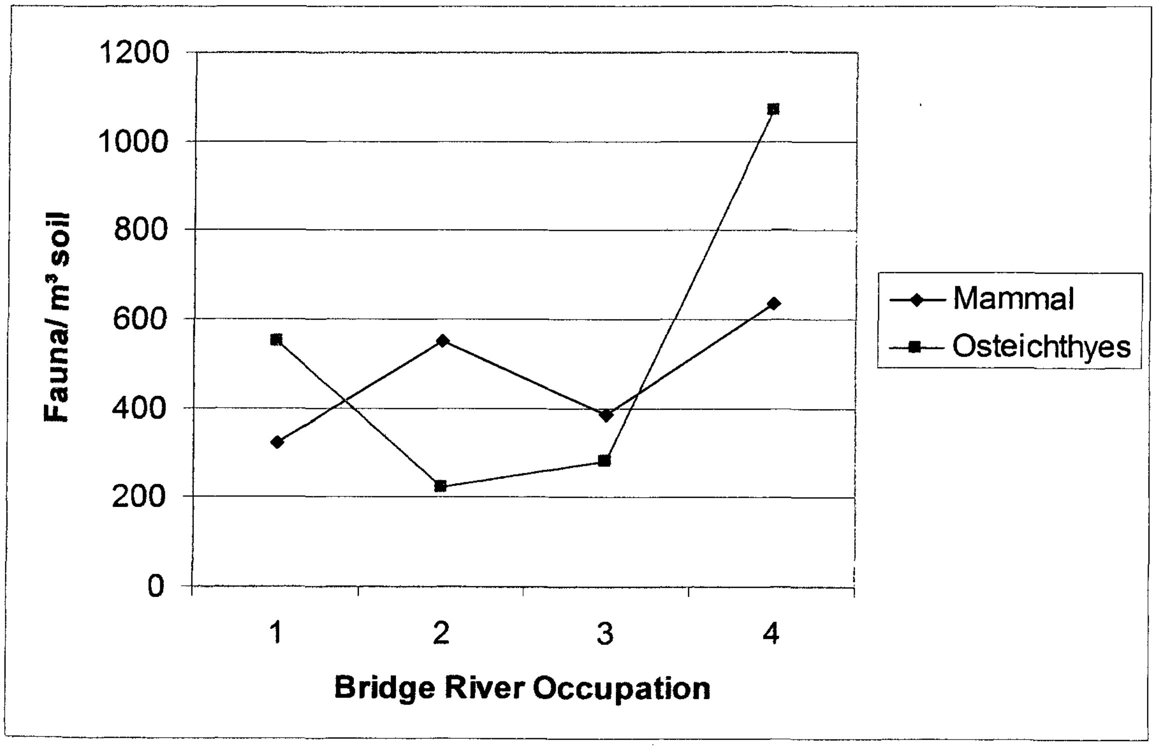

Figure 4-9: Mammal and Osteichthyes Remains, Identified to Taxon, Depicted as a Ratio to the Number of Dated Cubic Meters Excavated for Each Occupation.

Figure 4-10 explores the socioeconomic structure of the Bridge River village throughout its occupational history, by examining the distribution of mammal and osteichthyes remains, identified to taxon, according to housepit size. Throughout the occupational history of the site, the number of mammal and osteichthyes remains associated with large housepits fluctuates more than those recovered from medium sized housepits. The faunal data recovered from medium sized housepits shows more of a reliance on mammalian resources, and a decrease in both mammal and osteichthyes resources after Bridge River 2. Osteichthyes remains recovered from large sized housepits fluctuate the most throughout the occupational history of the Bridge River site.

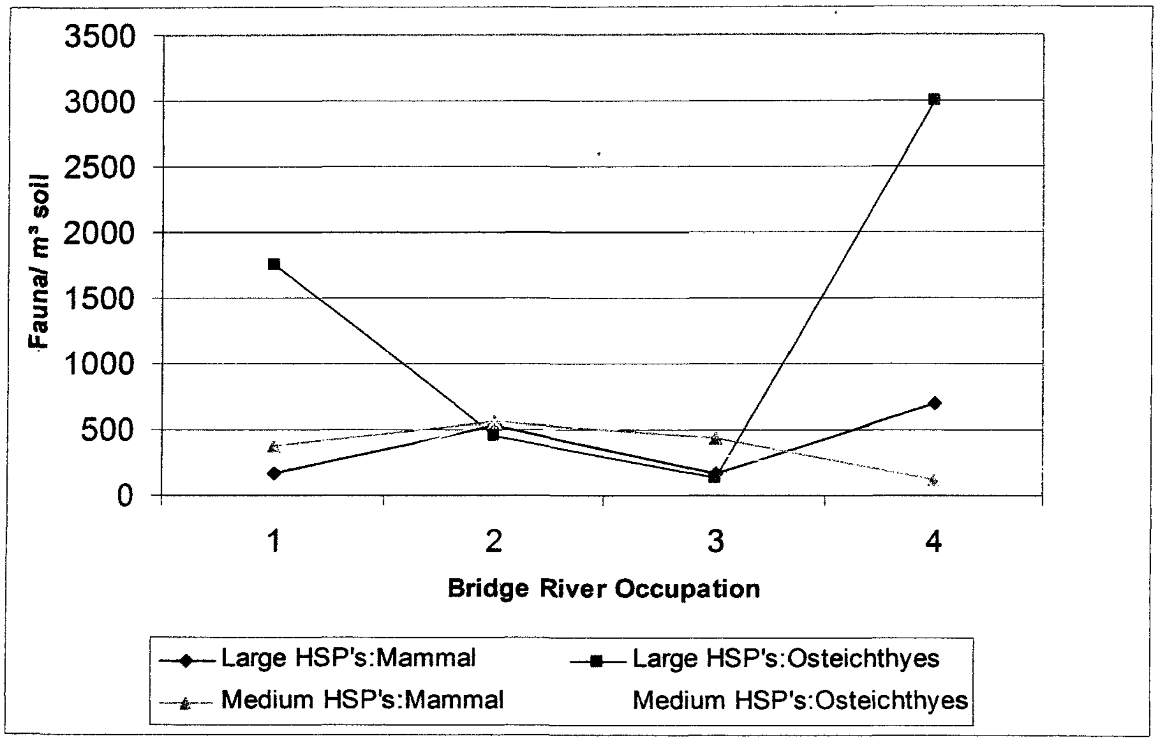

Figure 4-10: Mammal and Osteichthyes Remains, Separated According to Housepit Size, Depicted as a Ratio to the Number of Dated Cubic Meters Excavated for Each Occupation.

COMBINING BRIDGE RIVER OCCUPATIONS 1 AND 2

Bridge River 1 is only represented by a little over half a meter of soil excavated from seven different units. To avoid sample bias osteichthyes and mammal data identified to taxon from Bridge River 1 and 2, were combined in Figures 4-11 and 4-12. When Bridge River 1 and 2 data are combined, there were more mammal remains recovered from the first two occupations of the Bridge River site. Figure 4-12 represents the proportion of osteichthyes and mammal remains recovered from medium and large sized housepits calculated as a ratio to the total number of cubic meters excavated. Overall, the number of osteichthyes and mammal remains found within medium and large housepits decrease from Bridge River 1/2 to Bridge River 3, except for osteichthyes remains from medium sized housepits. The number of faunal remains recovered from medium sized housepits peaks during Bridge River 3 and then dramatically drops off in Bridge River 4. Clearly, there is a different predation strategy exhibited between medium and large sized housepits during Bridge River 4.

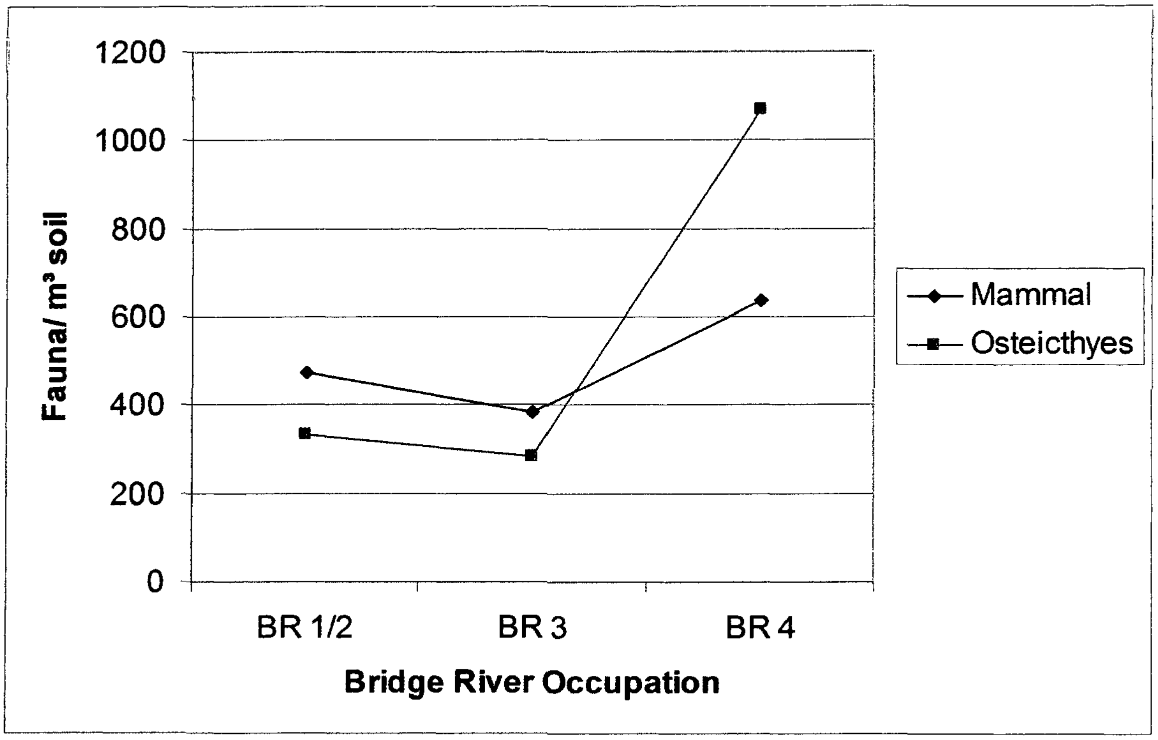

Figure 4-11: Mammal and Osteichthyes Remains Depicted as a Ratio to the Number of Datable Cubic Meters Excavated for Each Occupation when Bridge River 1 and 2 are Combined.

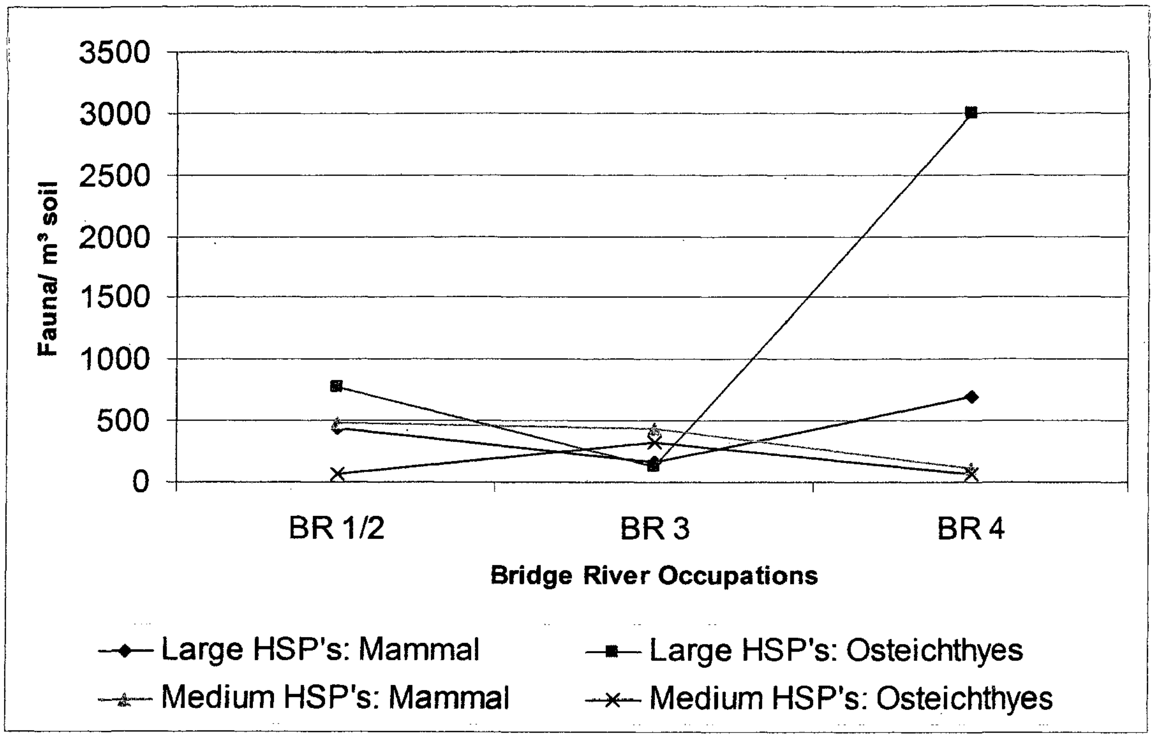

Figure 4-12: Mammal and Osteichthyes Remains, Separated According to Housepit Size, Depicted as a Ratio to the Number of Datable Cubic Meters Excavated for Each Occupation with Bridge River 1 and 2 Data Combined.

ELEMENT SURVIVORSHIP ANALYSIS

Similar to mammal bones, salmon bones exhibit different bone densities. To ensure that observed patterns within the salmon assemblage are not attributable to preservation factors, but rather are the result of cultural practices, an element survivorship analysis was performed. A low correlation between bone density and element survivorship increases the accuracy of subsequent cultural interpretations, because it allows the observer to account for preservation factors. For this analysis, the rank order density values calculated by Butler and Chatters (1994) will be compared to the rank order survivorship (% MAU) of salmon remains recovered from the Bridge River site.

Butler and Chatters determined the bone density of salmon remains by using X-ray absorptiometry on a variety of elements from ten chinook salmon. The bone density totals for the ten chinook salmon are thought to be representative and applicable to studies on other salmon species, because salmon are very similar. In addition, Butler and Chatters incorporated various sizes of chinook salmon into their study to account for size discrepancies found within all Pacific salmon species (Burns 2003; Butler and Chatters 1994). Table 4-5 demonstrates the mean volume bone density and bone mineral content of salmon species calculated by Butler and Chatters (1994). Figure 4-13 provides the salmon element volume densities, excluding the otolith.

Table 4-5: Mean volume bone density (VD) and bone mineral content (BMC) of salmon elements (Butler and Chatters 1994).

Element	*N*	VD (g/cm^3) S.D.	BMC (g) S.D.
Angular	10	0.20 0.02	0.23 0.15
Ceratohyal	8	0.06 0.01	0.10 0.06
Dentary	10	0.19 0.04	0.12 0.08
Exoccipital	9	0.11 0.01	0.17 0.10
Maxilla	10	0.20 0.04	0.24 0.14
Opercle	7	0.07 0.02	0.02 0.01
Otolith	10	1.41 0.15	0.07 0.03
Pterotic	8	0.12 0.02	0.17 0.13
Coracoid	10	0.07 0.01	0.04 0.02
Pectoral fin ray	9	0.29 0.05	0.03 0.02
Basipterygium	10	0.11 0.03	0.05 0.03
Vertebra type-1	8	0.27 0.04	0.09 0.05
Vertebra type-2	10	0.31 0.02	0.12 0.09
Vertebra type-3	10	0.34 0.02	0.16 0.08
Vertebra type-4	10	0.30 0.04	0.08 0.04
Hypural	10	0.14 0.04	0.07 0.06

(Table adapted from Burns 2003)

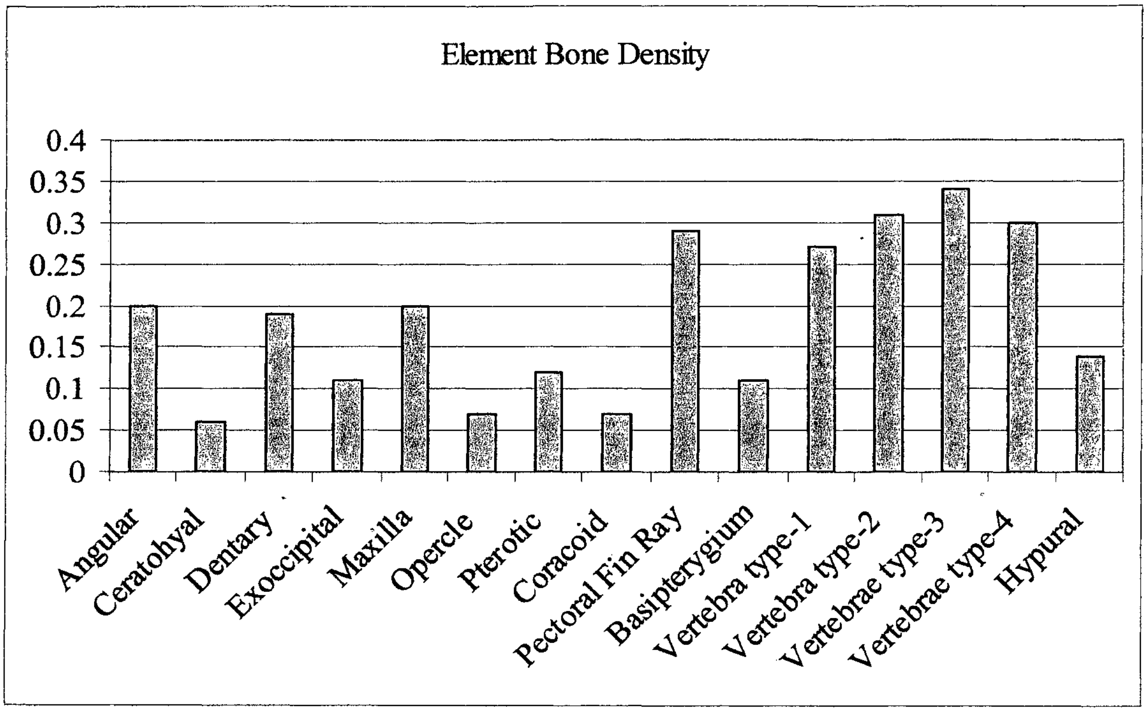

Figure 4-13: Salmon element volume density (VD), excluding otolith, which has a VD of 1.41 (Butler and Chatters 1994). (Figure adapted from Burns 2003)

Based upon Butler and Chatter's analysis it is apparent that the density of postcranial elements is much higher then cranial elements, excluding the otolith. The jawbones (angular, maxilla, and dentary) exhibit a higher density than the flat bones of the hyoid and gill cover (ceratohyal and opercle) as well as the spongy bones of the neurocranium. The paired basipterygiums and coracoids both exhibit low densities; however, the density of the pectoral fin ray is almost as high as the vertebrae (Butler and Chatters 1994). Several elements exhibiting low densities were recovered for each of the four Bridge River occupations, which indicates superior preservation.

The first step of the density survivorship analysis was to determine the NISP of Bridge River salmon elements utilized in Butler and Chatter's (1994) study. Table 4-6 provides the NISP of salmon elements to be used in the subsequent analysis. Next, the %MAU of the salmon bones to be used in the density survivorship analysis were calculated and then ranked. Binford (1978, 1984) developed %MAU in order to address the degree of variation in element representation. The first step in calculating %MAU was to determine which element was most prevalent within the remains identified as *Oncorhynchus sp.* for each Bridge River occupation. Next, this element was assigned an arbitrary score of one-hundred. The rest of the *Oncorhynchus* sp. elements utilized within the density survivorship analysis were then compared to the number of times a particular element occurs within a single salmon species. This was achieved by multiplying the number of times an element occurs within a single salmon species by one-hundred, and then dividing this quantity by the number of times that element was present within the Bridge River assemblage. By ranking element survivorship (%MAU), it was possible to run a correlation coefficient in reference to the ranked volume densities of salmon elements determined by Butler and Chatters.

Table 4-6: Number of Identified Salmon Species (NISP), Recovered from the Bridge River site, to be Used in Density Analyses.

Element	NISP BR:1	NISP BR:2	NISP BR:3	NISP BR:4	Single Species of Salmon
Angular	0	0	0	0	2
Certatohyal	0	0	0	0	2
Coracoid	1	0	2	0	2
Pectoral Fin Rays	0	0	0	0	17
Basipterygium	2	1	5	8	2
Vertebra 1	0	0	0	0	2
Vertebra 2	0	5	2	5	7
Vertebra 3	52	26	22	70	31
Vertebra 4	13	18	17	11	32

Table 4-7: Rank order salmon bone volume densities compared with element survivorship (%MAU) throughout the occupation of the Bridge River site.

Element	VD Rank	BR:1	Rank	BR:2	Rank	BR:3	Rank	BR:4	Rank
Otolith	1	0	5.08	0	5.08	0	6.09	0	6.09
Vert. 3	2	60	2	100	1	28.4	2	56.5	2
Vert. 2	3	0	5.08	84.5	2	11.44	5	17.75	4
Vert. 4	4	41	4	66.6	3	21.2	3	8.5	5
Fin Ray	5	0	5.08	0	5.08	0	6.09	0	6.09
Vert. 1	6	0	5.08	0	5.08	0	6.09	0	6.09
Angular	7.5	0	5.08	0	5.08	0	6.09	0	6.09
Maxilla	7.5	0	5.08	0	5.08	0	6.09	0	6.09
Dentary	9	0	5.08	0	5.08	0	6.09	37.5	3
Hypural	10	0	5.08	0	5.08	0	6.09	0	6.09
Pterotic	11	0	5.08	0	5.08	0	6.09	0	6.09
Exoccipital	12.5	0	5.08	0	5.08	0	6.09	0	6.09
Basipterygium	12.5	100	1	59.5	4	100	1	100	1
Opercle	14.5	0	5.08	0	5.08	0	6.09	0	6.09
Coracoid	14.5	50	3	0	5.08	20	4	0	6.09
Ceratohyal	16	0	5.08	0	5.08	0	6.09	0	6.09
		rs=.006		rs=.450		rs=.163		rs=.125	

As demonstrated in Table 4-7, the correlation between density and survivorship is low, which confirms that cultural or behavioral trends inferred from *Oncorhynchus* sp. remains are not the result of differing degrees of preservation resulting from varying bone densities. Similar to the weathering data, the element survivorship analysis has shown the Bridge River site to exhibit superior preservation.

Density survivorship analyses performed at the Keatley Creek site indicate that there is a low correlation between density and survivorship (Butler and Chatters 1994; Burns 2003). Again, this indicates bone destruction since the time of deposition has been minimal and the presence or absence of particular elements is most likely attributable to cultural processing behaviors. A low correlation between density and survivorship within prehistoric salmon assemblages recovered from the Bridge River and Keatley Creek sites signify that preservation is superior throughout the region.

RICHNESS AND EVENNESS SCORES

The actual number of osteichthyes and mammal remains recovered from the Bridge River site give the appearance that past tenants relied more on a mammalian orientated predation strategy during Bridge River 2 and 3. However, due to the highly fragmented nature of the mammal remains it is was only possible to identify 1% of them to the level of species, while it was possible to identity 98% of the osteichthyes remains. As mentioned previously, salmon are the number one ranked food source within the Mid-Fraser region. A more mammalian oriented diet could indicate changes in resource predation tactics. Therefore, another method of interpretation was necessary to evaluate the contribution of salmon and mammalian resources to the diet of the Mid-Fraser tenants.

The richness and evenness scores of the Bridge River faunal data were calculated to determine the predation history of the village. Richness measures prey spectrum, while evenness measures predation mode, which can range from pursuit to search (Chatters 1987, 1995). "A pursuit mode predator hunts for a specific prey and ignores other potential prey that it encounters, whereas a searching predator hunts for and takes any acceptable prey opportunistically" (Chatters 1995).

The first step in evaluating the evenness and richness of the Bridge River faunal assemblage was to calculate the NISP totals for each occupation as depicted in Table 4-8. Next, the richness of the Bridge River faunal assemblage was determined by simply counting the number of taxons identified for each occupation. Next, the evenness of the assemblage was calculated using Pielou's J (1966) (Table 4-9).

Table 4-8: NISP of faunal remains recovered for each Bridge River Occupation.

	***Oncorhynchus* sp.**	***Odocoileus* sp.**	***Canis familiaris***	***Sciurus carolinensis***	***Felidae***
BR: 1	316	3	0	0	0
BR: 2	236	2	1	1	0
BR: 3	709	14	2	0	1
BR: 4	978	4	0	0	0

Table 4-9: Richness (R) and Evenness (J) Data.

	R	J
Bridge River: 1	2	0.06
Bridge River: 2	4	0.08
Bridge River: 3	4	0.19
Bridge River: 4	2	0.07

The low richness and evenness scores indicate past tenants relied on a pursuit-mode, narrow-spectrum predation strategy concentrated almost entirely on the consumption of salmon resources. Tests revealed a low and insignificant correlation between sample size and richness ($r=-.275$, $P=.725$, $\alpha=.05$) and evenness ($r=-.343$, $P=.657$, $\alpha=.05$) scores. Despite the high number of mammalian fragments recovered from the site, it is clear past tenants were heavily dependent on salmon throughout the occupational history of the village. A high dependence on salmon resources, the number one ranked food source within the Mid-Fraser region, indicates past tenants of the Bridge River village did not experience resource depression.

RESULTS SUMMARY

The taphonomy of the Bridge River faunal data indicates superior site preservation due to the low degree of weathering, especially among bones recovered from older contexts. The frequent occurrence of bones measuring less than 2 centimeters in length indicates that bones are highly fragmented, most likely attributable to fracturing. Much of the faunal assemblage has been subjected to burning and instances of bone modification are relatively low. The ratio of osteichthyes and mammal remains in relation to the cubic meters excavated for each occupation indicates predation strategies varied throughout the occupational history of the site, while evenness and richness score demonstrate a continuous and intense reliance on salmon resources. Significantly more osteichthyes remains were recovered from large housepits occupied during Bridge River 1 and 4.

CHAPTER 5

DISCUSSION

The first part of this chapter compares the predation history of the village to environmental reconstructions for the Mid-Fraser region. Next, the social implications regarding the number of osteichthyes and mammal remains recovered from medium and large sized housepits for each occupational phase will be addressed. An assessment of the species and elements present within the faunal assemblage will also be discussed. Furthermore, the Bridge River faunal data is compared to parallel lines of evidence, such as lithic and prestige date, and then to Keatley Creek predation models.

BRIDGE RIVER PREDATION STRATEGIES COMPARED TO ENVIRONMENTAL RECONSTRUCTIONS

As discussed earlier in Chapter 2, environmental conditions during Bridge River 1 (1864-1696 B.P.) were warm and dry. Successive years of drought would have caused a decrease in salmon populations throughout the Fraser River system, and increased the importance of key fishing locales, such as the 6-Mile Rapids located 3.1 kilometers from the Bridge River site. Evenness and richness scores, in addition to the faunal remains identified to taxon recovered from Bridge River 1, both indicate a reliance on osteichthyes resources. This reliance may indicate that residents did indeed establish the Bridge River village to utilize the productive 6-Mile rapids fishery.

Environmental reconstructions indicate that during Bridge River 2 (1646-1414 B.P.) and Bridge River 3 (1375-1139 B.P.) the climate was cool and wet, which would have allowed salmon populations to thrive. In concert with environmental data, evenness and richness scores indicate that past tenants relied on a salmon dominated subsistence strategy throughout both occupations. Cool and wet environmental conditions would have caused forests to expand, resulting in a decrease in ungulate foraging grounds and geophyte and berry production. Throughout Bridge River 2 and 3, past tenants would have been faced with diminishing resources throughout the Canadian Plateau and plentiful salmon populations, especially within the Mid-Fraser region and at key fishing locales such as the 6-Mile Rapids. It would have been more lucrative for the past tenants of the Northern Plateau to mass harvest salmon at key fishing locales in the Mid-Fraser region, since salmon was the number one ranked food source.

The Bridge River village was virtually abandoned from 1138-639 B.P. The Mid-Fraser region experienced drought conditions between 1100 and 700 cal. B.P., which is when the Little Climatic Optimum peaks. As mentioned in Chapter 2, drought conditions cause a decrease in salmon populations. In contrast, drought conditions cause forests to retract, resulting in more grassland habitats for ungulates to feed and geophyte and berry plants to grow. Due to the increased availability of resources throughout the Canadian Plateau, the Bridge River tenants may have found it more cost effective to pursue and intensify their use of resources previously considered supplementary.

Once again, environmental conditions were cool and wet during Bridge River 4 (638-167 B.P.) As mentioned in Chapter 2, Chatters et al. (1995) established salmon populations on the Columbia River to be "good" during this occupation. Evenness and richness scores, in addition to the large number of osteichthyes remains recovered from Bridge River 4, definitely indicate a significant reliance on salmon resources. With the reintroduction of cooler and wetter environmental conditions onto the Northern Plateau, the Mid-Fraser region would have once again supported large salmon populations, especially at key fishing locales. It would have been more cost effective for the past tenants of the Bridge River village to mass harvest the salmon resources available to them within the Mid-Fraser region. The immense quantity and predictability of salmon resources most likely promoted the reoccupation of the Bridge River village.

The number of mammal remains recovered from Bridge River 4 show a slight increase from previous occupations. Although this increase should not be over interpreted, due to the fragmented nature of the mammal remains recovered from the Bridge River village, it is still possible to make some tentative inferences. Winters during Bridge River 4 may have been uncharacteristically long because of cooler and wetter environmental conditions, which would have decreased food supplies and increased the importance of acquiring game within the river valleys. According to Alexander (1992), winter hunts were only undertaken when food reserves were running low or the weather was mild. Moreover, cooler and wetter environmental conditions would have decreased ungulate foraging grounds and forced them to feed at the bottom or sides of river valleys and their tributaries (Rousseau 2004), making them easier to obtain. An increase in mammal remains during Bridge River 4 may also be attributable to changes in hunting strategies. The Mid-Fraser hunters may have organized communal hunts to more effectively use snares to acquire game within forested environments or blinds within more open areas (Alexander 1992).

Overall, it appears the Bridge River village was occupied during periods of enhanced moisture and cooler temperatures. The past tenants of the Northern Plateau most likely inhabited the Mid-Fraser region in order to mass harvest salmon resources, which would have been the number one ranked food resource. Cooler and wetter environmental conditions would have increased the search costs for ungulates, geophytes, and berries because of forest expansion. It appears resource intensification of salmon resources was the primary instigator for the occupation of the Bridge River village.

SOCIO-ECONOMIC IMPLICATIONS

When interpreting the socio-economic implications of the discrepancies in the number of salmon and mammal remains recovered from medium and large sized housepits for each Bridge River occupation, it is important to consider the highly fragmented nature of the faunal assemblage and to concentrate more on general predation patterns. Overall, the number of osteichthyes remains recovered from large housepits fluctuates considerably throughout the history of the village. Considerably more osteichthyes remains were recovered from large housepits occupied during Bridge River 1, which may represent the first occupants' reliance on the productive 6-Mile rapids fishery. Osteichthyes remains, recovered from large housepits, drop significantly from Bridge River 1 and 2, and even more so to Bridge River 3, which may be an early indicator of village abandonment. During Bridge River 4, large housepit osteichthyes remains increase dramatically, which is expected given the cooler and wetter environmental conditions. However, osteichthyes remains only increase in large housepits, which may indicate the presence of social divisions.

Such a large increase in osteichthyes remains, recovered from large housepits occupied during Bridge River 4, may have provided the economic flexibility for members of large housepits to devote more time to hunting pursuits, resulting in more mammalian remains within large housepits. According to ethnographic records, peoples of the Mid-Fraser region associated prestige with successful hunting endeavors (Kennedy and

Bouchard 1998; Romanoff 1992b). The increase in mammal remains recovered from large sized housepits during Bridge River 4, may be the result of an increased social investment in the procurement of mammalian resources for status and social gain.

SPECIES AND IDENTIFIED ELEMENTS

In total, 2,268 species and elements were identified for all of the Bridge River occupations. *Oncorhynchus* sp. remains consisted of the majority of identifiable species and elements present within the assemblage. *Odocoileus* sp. remains were the second most common identifiable species, consisting of a little more then 1% of the total assemblage. As a whole, mammal remains were difficult to identify due to the high degree of fragmentation present within the assemblage.

An interesting trend was observed when analyzing the types of *Oncorhynchus* sp. vertebrae recovered for each occupation. Throughout the occupational history of the site, significantly more caudal vertebrae were recovered in relation to thoracic vertebrae. This is significant because a typical salmon backbone contains of 31 caudal vertebrae and 32 thoracic vertebrae. Table 5-1 provides the percentage of caudal vertebrae recovered for each occupation compared to thoracic vertebrae.

Table 5-1: Percentage of Thoracic and Caudal Vertebrae for Each Occupation.

Bridge River Occupation	Percentage of Thoracic Vertebrae	Percentage of Caudal Vertebrae
Bridge River 1	20%	80%
Bridge River 2	37%	63%
Bridge River 3	46%	54%
Bridge River 4	13%	87%

Clearly, there is a cultural origin for the disproportionate number of caudal vertebrae in relation to thoracic vertebrae. The abundance of caudal vertebrae in relation to thoracic vertebrae does support ethnographic observations of a single filet of the whole fish attached to the backbone and ribs at the tail being produced (Romanoff 1992a). The consistency of increased numbers of caudal vertebrae throughout much of the village's history may represent a continuity in salmon processing techniques.

The percentage of thoracic vertebrae steadily increases from Bridge River 1 to 3, until it decreases sharply during Bridge River 4. More thoracic vertebrae indicate an increase in the number of frontal or neck proportions being dried and transported back to the village. As mentioned previously, Teit (1900) observed salmon caught late in the fall were often processed and stored without removing the backbones. It is during Bridge River 3 the village's population reaches its peak. Larger population levels may have increased the importance of filleting salmon quickly to ensure sufficient winter supplies were attained, resulting in filets with the neck or frontal portions still attached. In addition, groups may have been storing more of the salmon caught late in the fall without removing the backbones to compensate for growing population levels.

PARALLEL LINES OF RESEARCH

Lithic Data

During Bridge River 1/2 and 3, more mammalian remains were recovered then salmon remains, which indicates that past tenants may have been hunting more during these occupations. Correspondingly, more hunting gear was recovered from Bridge River 1/2 and 3 than from Bridge River 4, which provides additional evidence that hunting was more common during the first three occupations of the Bridge River village.

The number of osteichthyes remains peak during Bridge River 4, which is exactly when the number of light duty tools thought to be associated with fish processing climax. Overall, the lithic data provide support for the variation in mammal and osteichthyes remains recovered for each occupation of the Bridge River site; however, the majority of mammal remains were highly fragmented which almost certainly has affected the accuracy of observed changes in predation.

Prestige Data

When a ratio of prestige tools recovered from medium and large sized housepits in relation to the cubic meters excavated from dated strata was compared to a ratio of osteichthyes and mammal remains from medium and large sized housepits, Bridge River 4 produced some interesting results. "During Bridge River 4, there are almost twice as many prestige tools from large sized housepits versus medium size housepits" (Clarke et al. 2005). Osteichthyes remains, and to a lesser extent mammal remains recovered from this occupation, show a marked increase in large sized housepits, while the number of faunal remains recovered from medium sized housepits are relatively low. As suggested by Clarke et al. (2005), discrepancies in the number of faunal remains and prestige tools from large and medium sized housepits may suggest social inequality existed within Bridge River 4.

A COMPARISON OF BRIDGE RIVER DATA TO KEATLEY CREEK PREDATION MODELS

Hayden and Kusmer's Hypothesis

As mentioned previously, Hayden (1997, 2000a) and Kusmer (2000) hypothesize that the big village pattern emerged and was sustained within the Mid-Fraser region due the abundance and availability of salmon resources. Furthermore, Hayden and Kusmer postulate that mammals played a more supplementary dietary role, and past inhabitants of the Mid-Fraser villages relied heavily on salmon resources until a landslide blocked the Fraser River system approximately 1,000 years ago (Hayden and Ryder 1991; Kusmer 2000). Hayden and Ryder (1991) believe this landslide blocked salmon runs and compelled the inhabitants of the large winter pithouse villages to abandon them in search of other food resources. Hayden and Kusmer believe the diversity of animal resources consumed by the Mid-Fraser peoples at contact was the result of dietary changes that arose after the landslide.

The Bridge River richness and evenness data does indicate that the past tenants of the village did rely on salmon resources because of their abundance and availability within the Mid-Fraser region. The occupational phases associated with the Bridge River site do indicate village abandonment from 1138-639 B.P. Whether this abandonment is the result of a catastrophic landslide, or shifting climatic conditions that caused large winter pithouse villages to be maladaptive, will require further study.

Burns's Hypothesis

Burns's (2003) work at the Keatley Creek site recognizes a dietary shift that occurred at 1250 B.P. Mammalian resources became much more prominent and salmon remains less so. Fish bone counts from the Saanich core loosely dated after 1200 B.P. also indicate a decrease in fish productivity (Tunnicliffe et al. 2001). Evenness and richness scores have indicated the past tenants of the Bridge River site relied heavily on salmon resources. However, the abandonment of the Bridge River village, at approximately 1138 B.P., definitely indicates that the past tenants did implement a new subsistence strategy.

Burns's also observed that mammal bones recovered from the final occupation (1173-747 B.P.) of the Housepit 7 rim were less heat treated and exhibited a significant drop in bone breakage, which she attributes to an increase in the consumption of root and plant resources resulting in a reduction in dietary stress. Bridge River mammal remains recovered from this time frame also exhibit less heat treatment. Burns's attributes village abandonment to a decreased reliance on riverine resources, which eventually shifted subsistence pursuits away from the village. Village abandonment occurred earlier at the Bridge River site at roughly 1139 B.P. Perhaps, the Bridge River village was abandoned for the same reasons, but at an earlier time period.

DISCUSSION SUMMARY

Overall, I do feel there is a correlation between environmental reconstructions and past predation activities. With the exception of Bridge River 1, faunal data shows that during periods of enhanced moisture and cooler temperatures the village is occupied, and that the past tenants relied on a pursuit-mode, narrow-spectrum predation strategy focused almost entirely on salmon resources. The abundance of osteichthyes remains recovered from Bridge River 1, as well as evenness and richness scores, indicate a significant reliance on salmon resources. This may be attributable to the arrival of a new cultural system, reliant on a fishing economy into the Bridge River region. This discrepancy may also be the result of the first occupants' reliance on the 6-Mile rapids and salmon resources as a motivating factor for settling the Bridge River village. The increase in mammal remains during Bridge River 4 is slight and most likely not statistically significant.

CHAPTER 6

CONCLUSIONS

SUMMARY OF RESEARCH

The purpose of this study was to ascertain if predation patterns varied throughout the occupational history of the Bridge River village. Furthermore, predation patterns were compared to climatic data in an effort to determine if past environmental conditions caused either an increase or decrease in the number of mammal and osteichthyes remains. Next, inferences regarding the socioeconomic structure of the village, based upon the number of mammal and osteichthyes remains in relation to housepit size, were discussed. Finally, the predation history of the Bridge River village was compared to two conflicting predation models for the Keatley Creek site.

RESEARCH CONCLUSIONS AND IMPLICATIONS

In summary, predation practices throughout the occupational history of the village appear to have been concentrated almost entirely on the intensification of salmon resources. However, current research at the Bridge River site only provides a preliminary assessment of past predation strategies. Future studies addressing the impact and influence of environmental and socio-economic factors on predation strategies will be necessary in order to fully comprehend the predation history of the Mid-Fraser region.

Based upon taxonomic data, the predation history of the Bridge River site does seem to fluctuate in response to environmental shifts. The most significant aspect of the Bridge River faunal data in regards to environmental shifts was the abandonment of the village during the Little Climatic Optimum and the famous Medieval Droughts (1100-

700 B.P.). Both the Bridge River and Keatley Creek faunal data show a decrease in osteichthyes resources at about the onset of the Little Climatic Optimum. However, there is not evidence to suggest resource stress. Residents of the Mid-Fraser region clearly underwent a reorganization in subsistence strategies, and as a result found it more economically viable to do away with the semi-sedentary hunter and gathering lifestyle they had grown accustom too.

The adoption and implementation of new a new strategy is inherently risky and only occurs when groups are not in competition with their neighbors. Moreover, a decrease in competition may be the result of a catastrophe that wiped out the group's competitors or the result of an increase in environmental productivity (Chatters and Prentiss 2005). Tenants of the Mid-Fraser region may have experienced an increase in plant productivity with the onset of drought conditions around 1,100 years ago, which may have provided them with the increased environmental productivity necessary to implement a new subsistence strategy. Current research suggests that after 800 B.P. oven size decreased; however, Lepofsky and Peacock (1992) speculate that the decrease in oven size may have been compensated for by an increase in ovens utilized by smaller social groups in the uplands. Future research regarding the importance of plant foods throughout the Canadian Plateau at the time of abandonment within the Mid-Fraser region will be essential towards fully comprehending this subsistence strategy shift.

APPENDIX

MAPS, FIGURES, AND TABLES

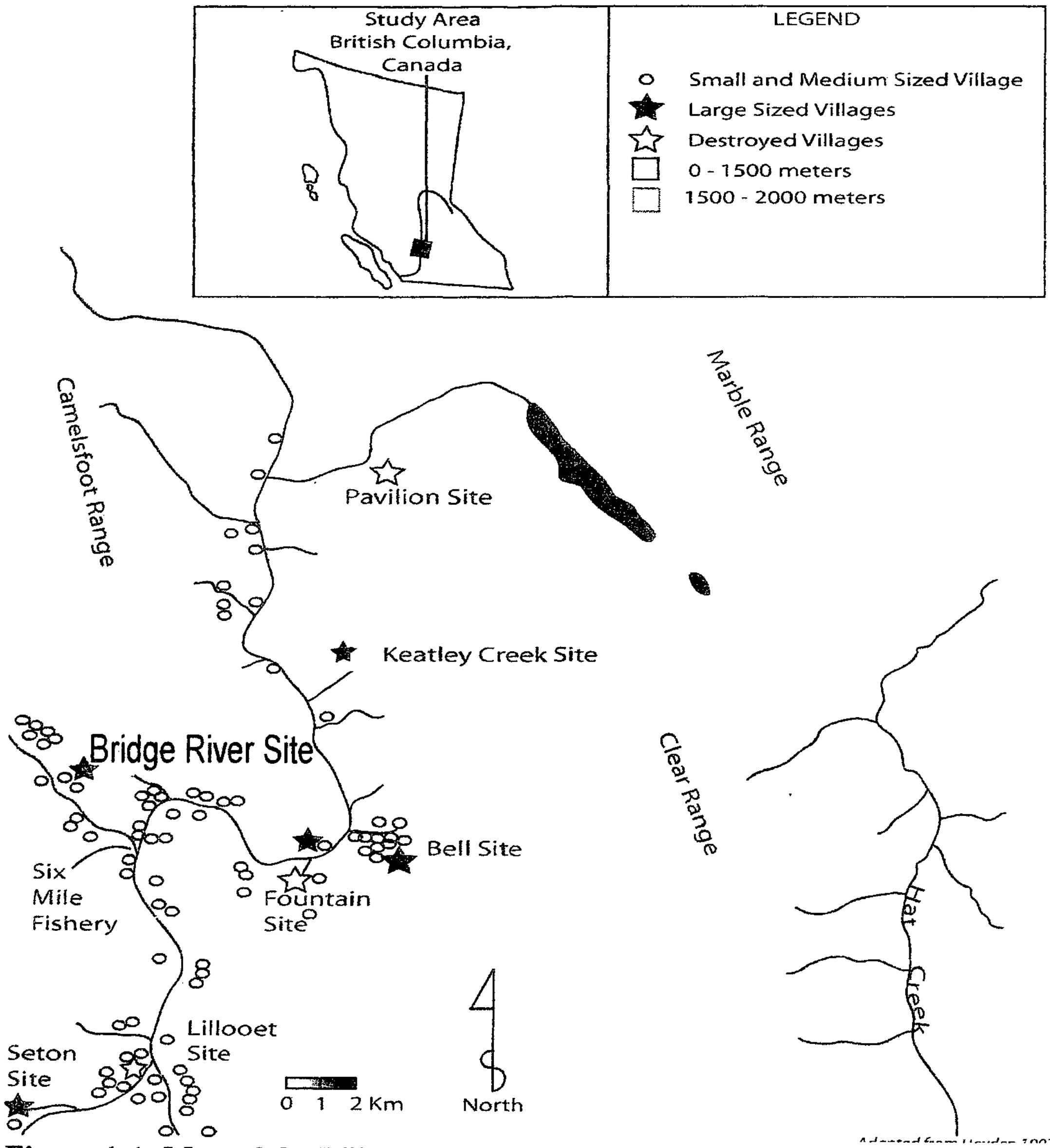

Figure 1-1: Map of the Lillooet Middle Fraser region with associated large prehistoric villages including the Bridge River Site (adopted from Hayden 1997).

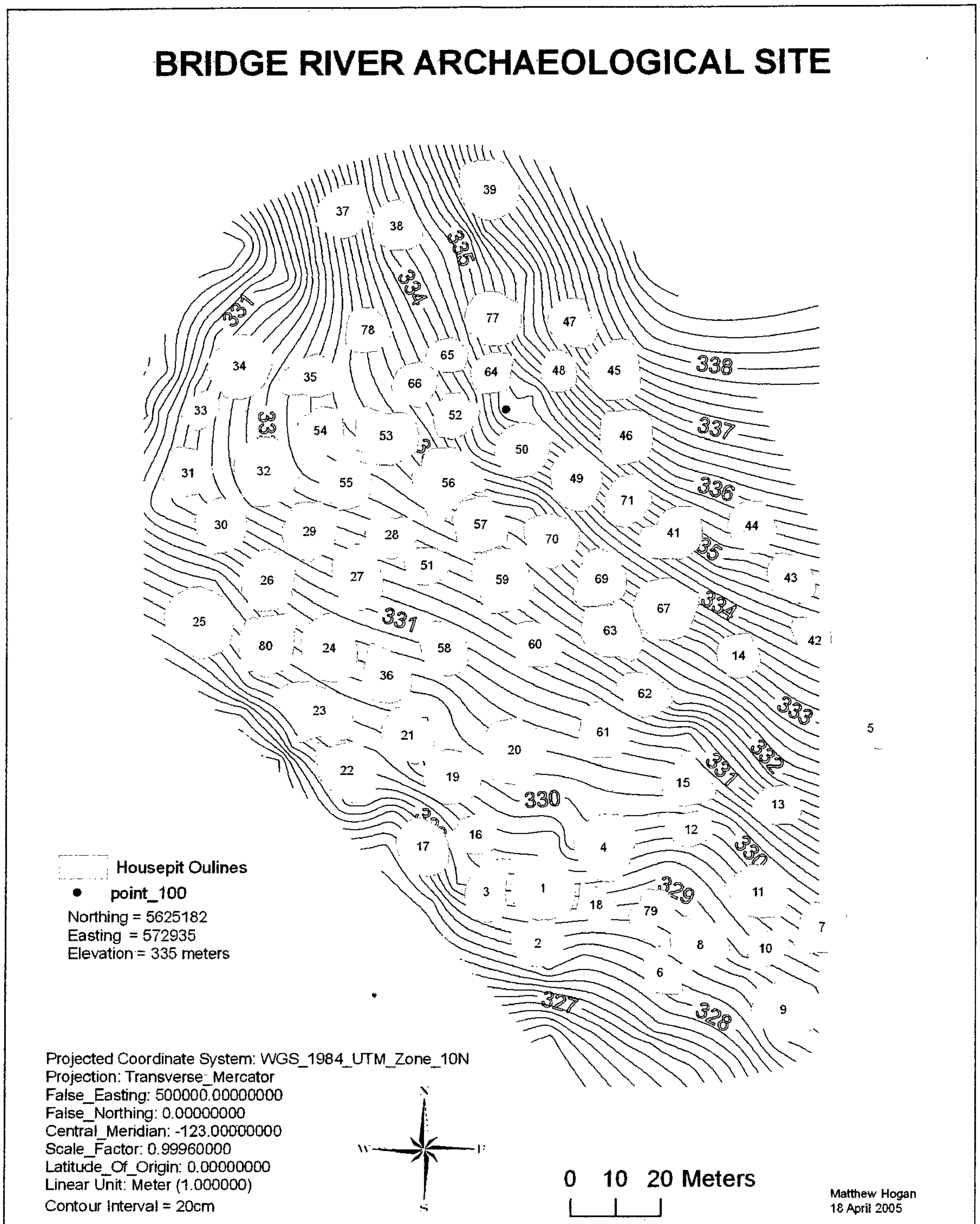

Figure 1-2: Topography Map of the Bridge River Site (Hogan 2005).

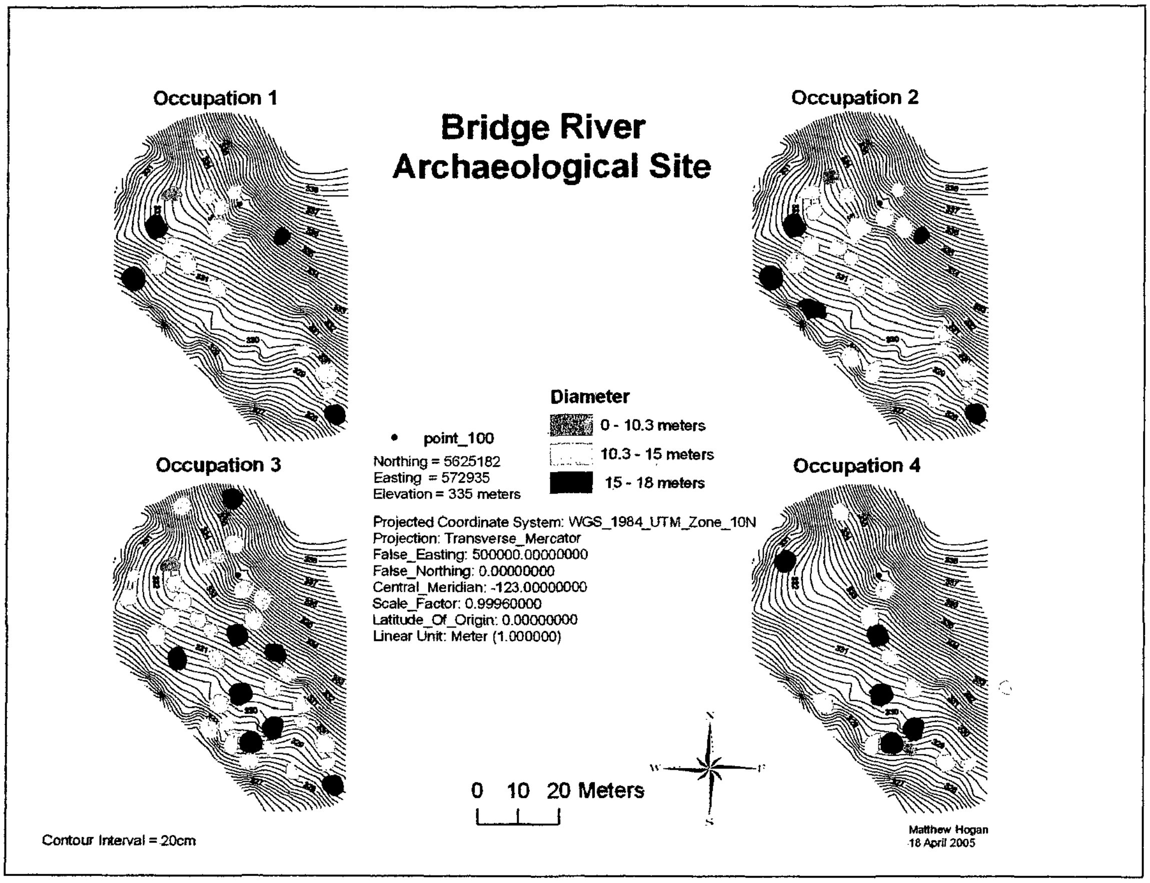

Figure 1-3: The Four Occupations Associated with the Bridge River Site (Hogan 2005).

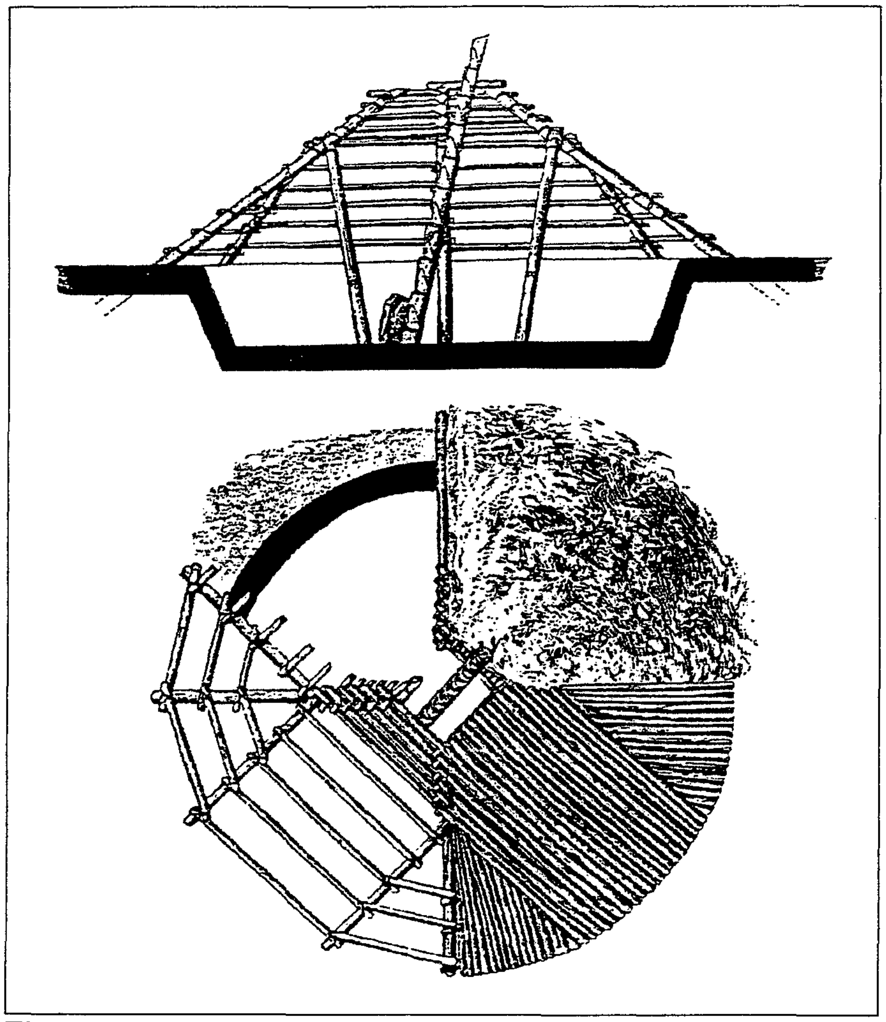

Figure 2-1: Illustration of a pithouse, by James Teit (1900).

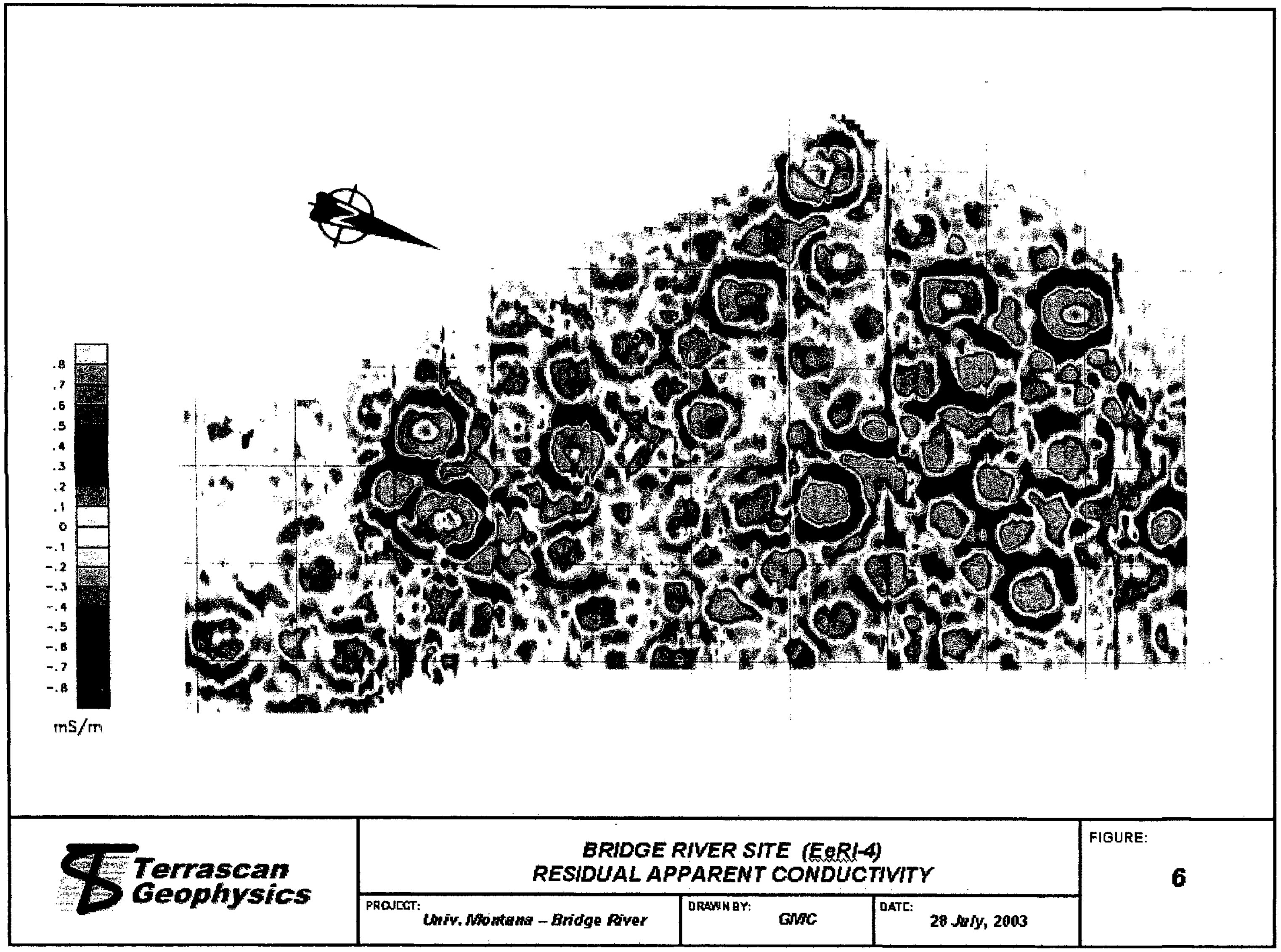

Figure 3-1: Residual Apparent Conductivity (Cross 2005).

Table 3-2: Cubic Meters Excavated for Each Occupation According to Housepit Number and Size (Clarke 2005).

Housepit Number	Housepit Size	Phase of Occupation	Cubic Meters Excavated	
9	L	1	0.05	
				Cubic Meters
25	L	1	0.075	BR 1
26	L	1	0.0375	0.575
27	M	1	0.1	
38	M	1	0.0625	
52	M	1	0.0875	
58	M	1	0.1625	
3	M	2	0.0375	
6	M	2	0.015	
11	M	2	0.0825	
15	M	2	0.075	
				Cubic Meters
23	L	2	0.125	BR 2
26	L	2	0.025	1 11
28	M	2	0.0125	
32	L	2	0.1425	
35	M	2	0.05	
48	M	2	0.13	
49	M	2	0.065	
50	L	2	0.025	
54	M	2	0.025	
56	L	2	0.025	
64	M	2	0.1125	
71	L	2	0.1375	
78	M	2	0.025	
1	L	3	0.1125	
3	M	3	0.0625	
				Cubic Meters
12	M	3	0.1375	BR 3
16	M	3	0.1175	2.5125
17	M	3	0.1	
18	M	3	0.03	
19	M	3	0.0125	
20	L	3	0.075	
24	L	3	0.075	
28	M	3	0.025	
29	M	3	0.15	
31	M	3	0.1125	
33	M	3	0.09	
37	M	3	0.1075	
39	L	3	0.0375	
51	M	3	0.0425	
54	M	3	0.1125	
55	M	3	0.075	
58	M	3	0.0425	
59	L	3	0.07	

60	M	3	0.125	
61	M	3	0.0625	
62	M	3	0.1375	
63	L	3	0.1	
65	M	3	0.13	
66	M	3	0.15	
70	M	3	0.03	
77	M	3	0.19	
3	M	4	0.1	
4	L	4	0.0775	
5	M	4	0.1	
8	M	4	0.0875	
				Cubic Meters
10	M	4	0.0325	BR 4
18	M	4	0.04	0.9375
20	L	4	0.0875	
22	M	4	0.0625	
34	L	4	0.025	
50	L	4	0.1325	
57	M	4	0.1425	
60	M	4	0.05	

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